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A
PRACTICAL TREATISE
ON
THE HUMAN TEETH:

Showing the cause of their Destruction, and the Means of their Preservation. By WILLIAM ROBERTSON, Surgeon Dentist, Birmingham. Third Edition. With Plates. London: John Churchill. Edinburgh: Maclachlan and Stewart. Dublin: Fannin and Co. Birmingham: Richard Davies.

CRITICAL ANALYSES.

“His observations seem to be the result of much experience in the practice of dental surgery, and we have no hesitation in recommending it to the notice of those who devote their attention to the practice of this art.”—*The Edinburgh Medical and Surgical Journal*, January 1, 1840.

“We recommend the careful perusal of the above treatise, which is strictly practical, and even popular in its character, to all persons interested (and who is not?) in the preservation of their own teeth, or that of their children. We firmly believe that a general acquaintance with the principles of Mr. Robertson's theory, and the consequent periodical examination of the teeth, which such an acquaintance would produce, must tend most materially to diminish the frequency of a most painful and annoying disease, and render the economy of the mouth an object of daily and profitable attention. The simple and clear manner in which the facts contained in Mr. Robertson's book are set forth, their important application, and the facility with which the proofs brought forward in support of the theory, may be comprehended by even unprofessional readers, must render the present publication not only an important improvement in modern dental surgery, but also a valuable and useful contribution to the public at large.”—*Medico-Chirurgical Review*, April, 1840.

“We have given to Mr. Robertson's treatise a most careful examination in its relations, facts, and consequences, and can unhesitatingly admit the truth of his theory, as corroborated both by external and internal evidence. We congratulate ourselves and the public, not so much upon the discovery of the true cause of caries of the teeth, but that this discovery indicates a sure plan not only of cure, but of the prevention of caries, which no other theory has yet accomplished.”—*The Analyst*, Oct. 1839.

“We rejoice, that this excellent practical work has received that attention from the public which it eminently deserves. . . . The publication is extremely valuable, full of information popularly conveyed, and contains a more general and scientific outline of the nature and structure of the teeth, together with the minute practical details for their management in health and disease, than, we believe, will be found in any other work devoted to the subject.”—*Atlas*, July 27, 1839.

“A second edition of a work of this kind speaks well for its merits; and, in the present instance, seems well deserved.

The author points out the danger of not attending to the beginning of caries at an earlier period of life than is usually expected. His general views of the disease, and his advice to unprofessional persons, are valuable and practical, so that we may safely recommend his volume to all."—*The Literary Gazette*, November 9, 1839.

"We are glad to perceive that Mr. Robertson is steadily following up his researches on a very important part of organization with his accustomed clear-sightedness and success. We were surprised by the novelty and boldness of the opinions started in his first edition; but experience has developed nothing to indicate their fallacy. . . . From all these we consider the author has fairly established the correctness of his theory, and the fallacy of those founded upon inflammatory action. The descriptive portion of the work, with its illustrations, are executed in the very best style."—*Morning Post*, January 3, 1840.

"We have read this work with very great interest. Looking to the subject, which, at first view, certainly does not seem to possess much attraction for the general reader, this may seem merely a reviewer's flourish, but it is true, perfectly true, nevertheless; and no one who takes up the book but will acknowledge a similar feeling, and by doing so, afforded the strongest proof that Mr. Robertson has eminently succeeded in that very difficult task, imparting a popular interest to a professional subject. It has been his aim to do so, and his success has been complete. In this treatise Mr. Robertson teaches a new doctrine regarding the original cause of disease and decay of the teeth, and one at variance with that which has been hitherto entertained and promulgated by professional men—some of them of great eminence. This doctrine or theory is, that caries of the teeth proceeds originally, not from inflammation in the tooth as hitherto supposed, but from chemical action, resulting from the decomposition of particles of food lodged in the cavities and crevices of the teeth, which, in time, have the effect of corroding and destroying the enamel. Decay of the interior substance of the tooth follows; and inflammation of the numerous vessels that line its inner walls, the consequence of exposure, succeeds, and hence the pain of tooth-ache. Inflammation is thus, according to Mr. Robertson, the result and not the cause, of caries in the teeth; and he supports his opinion by a description of proof of so convincing a nature as to leave no doubt whatever of the correctness of his theory. At first sight it may not appear to the non-professional reader of much consequence which is the true original cause of caries in the teeth, whether inflammation or chemical action. But it is, in reality, of the last importance, as regards not only the subsequent treatment of these organs, but as regards the prevention of their decay, and all the tortures of tooth-ache. Until the non-professional reader however has perused Mr. R's treatise, he can have no adequate idea of this; and we

therefore recommend every one who has not already enjoyed this advantage, to read it without delay. It may be the means of saving them from much physical suffering, and will certainly point out a method by which they may add greatly to their comfort."—*The Scotsman*, Dec. 16, 1840.

"Mr. Robertson's doctrines altogether differ from those of the most eminent authors before him, and from the generally received opinions. The compass we can allow for reviews will not permit us to consider in detail the several points of difference enumerated; a very summary notice of them will suffice to show their value, and the important changes and benefits they are calculated to effect in practice."—*Midland Counties Herald*, July 25, 1839.

"His treatise on the teeth may perhaps without fear, be pronounced to be the best extant. He traces the causes and progress of their diseases, and gives full and efficient directions for their prevention and cure.....Mr. Robertson's is a *family* book, and ought to be consulted by all parents, that they may know how to alleviate or prevent keen suffering in their children."—*Birmingham Advertiser*, July 18, 1839.

"The principle and the practical deductions brought forward in Mr. Robertson's treatise, are supported by an immense body of arguments, drawn both from science and extensive experience, which appear to be unanswerable."—*Birmingham Gazette*. July 22, 1839.

"And with these quotations we will conclude our review of his highly valuable book, which, in our opinion, is not only a great addition to the science connected with the subject of which it treats, but must produce the most material improvements in the art which he so ably exercises."—*Staffordshire Advertiser*, September, 1839.

"This work has two strong recommendations—the intelligence and practical skill of the author, and the popular style in which it is written.....Mr. Robertson's treatise is by far the best we have seen on the subject, and it is one which every head of a family ought to have in his possession."—*Berrow's Worcester Journal*, August 8, 1839.

"This is a work of great merit and value.....Mr. Robertson has conquered the difficulty which the professional man always has in writing for the unprofessional—of making himself understood. He has treated the subject in a most rational and convincing manner.....We have written thus urgently because we are convinced that intelligent parents need only be acquainted with this book, and conscientiously act upon its advice, to place their children in a wonderfully better position, in regard to their teeth, than most persons of the present generation enjoy; and we, therefore, earnestly commend Mr. Robertson's treatise to their most serious study."—*Sheffield and Rotherham Independent*, Sept. 21, 1839.

"The public and the profession are already much indebted to Mr. Robertson, for his persevering researches in this inter-

esting department of medical science; and the volume before us will be received as a valuable contribution to the knowledge we already possess of the physiology of the teeth, and the best means of remedying or preventing the calamities to which these organs are liable.....We shall content ourselves with making one more extract, and then leave such of our readers as are able fully to appreciate the beauty and importance of a good set of teeth, to refer to the treatise itself, being thoroughly persuaded that few, if any of them, after consulting its valuable pages, will be found without so excellent a guide in future."—*Leamington and Warwickshire Standard*, August 31, 1839.

"We can safely say that few books have been laid on our table from which we have derived more instruction, or which we have read with more pleasure."—*The Staffordshire Examiner*, May 16, 1840.

"The object of this work is to make the general reader acquainted with the insidious nature of the diseases to which the teeth are liable, to explain to him their causes and progress, and to show that a knowledge of these is absolutely necessary, either by early attention, entirely to prevent their occurrence, or, by timely application, to counteract the mischief before it has become irremediable. Mr. Robertson, who is a professional gentleman, in extensive practice at Birmingham, has most successfully accomplished his object. His work is really practical; he dissipates popular errors; he thoroughly divests the subject of every thing that a non-professional person would expressively term *humbug*; utility is his guiding star."—*Gloucestershire Chronicle*, April 18, 1840.

"We are not, we feel certain, speaking in terms of exaggerated praise, when we declare that this is one of the most useful works, on the subject, it has ever fallen to our lot to peruse."—*Wolverhampton Chronicle*, Sept. 23, 1840.

"Affording the best instruction on subjects which might be sought for elsewhere in vain."—*Cheltenham Examiner*, Sept. 9, 1840.

"Mr. Robertson has evidently given great attention to the subject, and has been guided in his views by long and patient experience."—*Edinburgh Evening Courant*, Oct. 12, 1840.

"The book will be read with great advantage by the heads of families, and it will enable them, by a little care and attention, to prevent much acute suffering in their households,"—*Cheltenham Chronicle*, Sept. 10, 1840.

"A book which has already been pronounced, by the highest medical critical authorities, as a complete manual of all that is known of the teeth."—*Worcester Herald*, Oct. 31, 1840.

"It is the most talented and best written work of the kind we ever met with."—*Ten Towns' Messenger*, Aug. 28, 1840.

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SHOWING
THE CAUSES OF THEIR DESTRUCTION, AND THE
MEANS OF THEIR PRESERVATION.

WITH PLATES.

BY
WILLIAM ROBERTSON.

"WHAT ARE MERE OPINIONS WORTH?—ANY MAN MAY GIVE AN OPINION.
I MUST HAVE FACTS."—*Percival Pott.*

THIRD EDITION.



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TO

WILLIAM LAWRENCE, ESQ., F.R.S.,

THIS TREATISE

IS RESPECTFULLY INSCRIBED

BY

HIS OBLIGED AND OBEDIENT SERVANT,

THE AUTHOR.

PREFACE

TO THE FIRST EDITION.

IN the course of a long and extensive practice, my attention has been often forcibly drawn to the great and too frequently irreparable mischief which has arisen from the want of a correct knowledge on the subject of caries, or decay of the teeth. It is generally assumed, that the structure of the teeth is similar to that of the other parts of the body; and consequently, that in the former as in the latter, the commencement of disease will necessarily be attended with pain, and that it will be time enough to apply for advice when pain has occurred. I have, however, in the pages of this treatise shown the fallacy and danger of this mode of viewing the subject, and pointed out the incurable mischief which will be its inevitable result. I have been anxious to re-

move another popular error, relative to the period of life when the teeth are the most subject to caries. I have shown that in youth, when it is least suspected, the liability to caries is greatest, and that its approaches are then to be the most attentively guarded against.

The few works of authority hitherto published on the diseases of the teeth, are almost exclusively intended for the instruction of the medical student; and are necessarily, on that very account, but little adapted to afford information to the general reader. I trust that a careful perusal of the following pages will show how important it is that the latter, even more than the former, should possess an accurate knowledge of this subject. The evils resulting from a want of this knowledge may, in general terms, be considered of two kinds. In the first place, patients ignorant of the predisposing and exciting causes of caries, are not able to detect its presence until its destructive progress has placed the case beyond the means of remedy; and, secondly, it renders a large portion of the community the dupes of a class of practitioners, who can only be des-

ignated by their proper title of charlatans, and whose absurd pretensions and promises of relief might well be thought too extravagant for the present age, if the instances of mischief produced by their nostrums were not so numerous.

As one of my objects, indeed the chief one, has been to make the non-professional reader acquainted with the nature and progress of caries, and with the preventive and remedial measures which it is necessary to adopt, I have entered no farther into the consideration of the anatomical structure of the teeth and of the parts connected with them, than appeared to me absolutely necessary in order to make that part of the subject, which is by far the most important, clear and intelligible; and this course I have pursued without hesitation, since the works of Hunter, Fox, and Bell, will furnish the most ample anatomical information to those whose tastes or pursuits would lead them to enter more deeply into this inquiry.

The theories hitherto advanced to explain the origin and progress of caries, and which have possessed most weight and influence both with the profession and with the public, I have

considered it right to submit to a free, though I hope not an uncourteous criticism; because they are not only inadequate to explain the phenomena of caries, but are essentially fallacious, and have a tendency to lead their readers, in imaginary security, to wait till pain has been produced.

The theory, however, which I have advanced explains all the phenomena of caries, and accounts for all those circumstances which previous authors regarded as inexplicable anomalies. It is strictly a legitimate deduction from facts which any one may examine for himself; and it possesses the advantage over the explanations hitherto given, of showing how caries may, in a great majority of cases, be altogether prevented. It explains the fact that a tooth cannot be saved after decay shall have arrived at a certain stage; and teaches us how to detect the mischief at its early commencement, to arrest its progress, and to prevent its recurrence.

THE SQUARE, BIRMINGHAM,

July 2, 1835.

PREFACE

TO THE SECOND EDITION.

THE former edition of this work appeared in 1835. The subject was not laid before the public without mature consideration. The opinions then advanced were in direct opposition to the most popular treatises upon the diseases of the teeth; but they were grounded upon facts collected during sixteen years of extensive practice and minute observation,—facts which I felt persuaded would not admit of contradiction. Subsequent experience has produced no change in my former views. The numerous cases which have come under my notice since the first edition was published, have only confirmed my previous statements, and afforded me an opportunity of furnishing the reader

and that their destruction is effected by chemical, and not by inflammatory action. I have proved this, from the partiality of caries in attacking particular teeth, and particular parts of them;—from decay never commencing upon the plain and smooth surfaces of the teeth, but always in the pits, fissures, and interstices of these organs, where the food is retained, and undergoes decomposition;—from these facts I have proved that decay of the teeth is the result of chemical action. Also from the greater frequency of decay in youth than in the after periods of life;—from the liability of the teeth to decay in pairs;—from the hereditary predisposition to it often observed in the teeth of different families;—from the absence of pain so long as decay is confined to the enamel and bone;—from caries always commencing upon the surfaces of the teeth, and never internally;—from the fangs of the teeth being entirely exempted from caries, so long as they are embedded in their sockets, and protected from the influence of external agency;—from the circumstance of decay attacking artificial teeth in a similar manner,

as it does those naturally connected with their sockets; from the teeth of the lower animals being almost in every instance exempted from caries;—from the nature and success of the operations performed in dental surgery, such as permanently arresting the progress of decay by filling and filing the teeth;—from these, and various other circumstances connected with caries of the teeth, I have proved that the theory which I have advanced must be correct, and that the theories grounded upon inflammatory action must be fallacious.

A correct view of the cause of the destruction of the teeth, has necessarily led to a different mode of treatment from that formerly adopted for their preservation. I have accordingly, in the second part of the work, laid down rules for the general management of the teeth which, if acted upon, will, I feel persuaded, be the means of preserving these organs in ninety-nine cases out of a hundred where they are now lost.

It has been my endeavour, as much as possible, to avoid the use of technical terms, and to convey my ideas in familiar language;

and if I have succeeded in making myself clearly understood, and in convincing the public of the necessity of having recourse to the means which I have recommended, much inconvenience and suffering will be prevented, and my object will be fully attained.

THE SQUARE, BIRMINGHAM,

June 24, 1839.

PREFACE

TO THE THIRD EDITION.

IN presenting a third edition of this work to the profession and the public, I feel it to be my duty to acknowledge the flattering reception with which the first and second editions have been honoured. This, and the favourable reviews of the last edition of this monograph, I consider a sufficient warranty, should any be needed, for its appearance in the present enlarged, and I hope, amended form.

The opinions which I previously entertained and expressed, subsequent experience has tended to confirm, and it is no small satisfaction to me to perceive that the principles which I have long been endeavouring to impress upon the public mind have met with approval, and are being carried into practice, by the

more intelligent class of the community; this inference is grounded upon the changes which I have witnessed in the habits of my own patients, who are become aware of the absolute necessity of attending to their teeth in the absence of pain, instead of waiting for its occurrence and until the evil becomes irremediable.

The old theory of inflammatory action being the exciting cause of caries had a tendency to lead to an opposite practice; and it is on this account that my attention has been further directed to the subject in the present edition of this work.

THE SQUARE, BIRMINGHAM,
October, 10, 1842.

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A PRACTICAL TREATISE
ON
THE HUMAN TEETH.

INTRODUCTORY REMARKS.

MAN is endowed with reasoning faculties which enable him to comprehend the nature of many of the ailments to which he is liable, and means are placed within his reach with the capacity of judging of their efficacy, so that by the judicious choice and application of such means he has often the power of mitigating his sufferings, and, in many instances, of avoiding them. Man is not only endowed with the capacity of acquiring a knowledge of the nature of his complaints and the means of relief, but he also has engrafted in his constitution a sense of feeling which performs the office of a faithful sentinel, and warns him upon the slightest approach of danger. If this were not the case, if man were constituted insensible to pain, an organ upon which his existance depended might be attacked and destroyed, and death might ensue without any previous warning.

May not this association of pain, in most cases with the very commencement of the destruction of the parts of which the body is composed, be a wise and beneficent design for the purpose of calling our attention to the circumstance, in order that we may desist from what has a tendency to injure us; and also for the purpose of spurring us on in time to the use of means calculated to restore these parts, when diseased, to a state of health?

My object in these remarks, is to shew that this association of pain with the commencement of injury is *not* applicable to the teeth;—it is the very reverse of this with a tooth;—there is no uncomfortable sensation at the commencement of injury;—no pain to call attention to the mischief which is going on, until its destruction has been effected beyond the means of remedy. This is a fact that most persons are ignorant of, and the loss of the teeth, which is of so frequent occurrence, may be fairly attributed to ignorance of this circumstance.

The membrane, the sensitive part of the tooth, is contained in a small cavity in the centre of the tooth; the surrounding walls are not organized, consequently they are void of feeling; the attack is always made from without, never from within, and it is only when a breach has been made through the whole thickness of the walls, and the small chamber within laid open, that pain is felt;—but felt when it is too late for cure. A flesh wound will close, a broken bone will unite, but a breach made through the walls of a tooth can never be repaired—there is no restorative power in their composition, consequently, the vessels remain exposed, and destruction is the result.

The Dentist may be well informed, he may have a correct knowledge of the cause of the destruction of the teeth, and the mode of preserving them; but this is not sufficient: it is of equal importance that the patient should not be ignorant of the nature of the attack, otherwise he will fail to apply for assistance until it is too late.

The object of the present work is to make the general reader acquainted with the insidious nature of the diseases to which the teeth are liable; to explain to him the causes and progress of these diseases, and to show that a knowledge of them is absolutely necessary, either, by early attention, entirely to prevent their occurrence, or, by timely application, to counteract the mischief before it shall have become irremediable.

It may be safely asserted, that none of the organs of the human body are so often the subjects of disease as the teeth; none, the diseases of which are so little understood, and yet, when rightly comprehended, none, more completely under individual control. When we reflect how few persons there are who have not experienced some of the ill effects of diseased teeth, and how many there are to whom they occasion constant annoyance and pain, it is surprising that the subject should have so long escaped the minute attention of the medical pathologist.

The celebrated John Hunter may be said to have been the first to enter upon this investigation, in his *Treatise on the Natural History of the Human Teeth*, which appeared in 1771; and, as an anatomical pro-

duction, this work must be allowed to stand pre-eminent; for so fully and so successfully has he treated this part of the subject, that he has left but little of importance for succeeding authors either to add or to improve.

Mr. Hunter, seven years afterwards, published a practical treatise on the diseases of the teeth, intended as a supplement to the former work; but it can be no detraction from Mr. Hunter's reputation to state, that on this subject, he has not been so successful as on the former; for it is well known that he did not devote much of his time to the practice of this branch of surgery, which at that period was imperfectly understood, and but little attended to: indeed, it is only within the last thirty years that dental surgery has become the exclusive profession of a distinct class of medical men.

Mr. Hunter, had not, therefore, the advantages which may be derived from long and extensive practice, nor had he the opportunity of benefitting by the observations of previous authors; nevertheless, without the aid of these advantages, he approached nearer to the discovery of the origin of decay in the teeth than any subsequent author.

Mr. Hunter, in the commencement of his inquiry into the nature of this disease, very justly observes, that there is something more than mortification or a death of the part; that there is some operation going on, that is to say, some progressive morbid action, producing a change in the diseased part; and, after

having minutely described the external character of the disease, and its first appearance on the enamel of the tooth, and most correctly distinguished the teeth and the parts of them most liable to its attacks, perceiving also that a disease originating in an inorganic substance could not arise from disorder of the vascular system and vitality of the tooth, and yet not being able to discover an external cause which would account for a disease so partial in its attacks on particular teeth and particular situations of them, he gave up the investigation without discovering the true nature of the disease, and the agency by which it is produced.

The two best treatises which have appeared on the diseases of the teeth, since those of Mr. Hunter, have proceeded from writers who have practised dental surgery as a distinct profession; the one by Mr. Fox, in 1806, and the other by Mr. Bell, in 1829. Each of these authors has promulgated a theory on the nature and origin of decay of the teeth, and both with the professed object of supplying the deficiency of Mr. Hunter. These two scientific and able writers are considered the principal authorities in their particular department of the profession; and their views may be said to represent the opinions of its members generally.

I might here introduce a host of authors, English, French, and German, who have written upon the teeth in our own day, and I might also lay before my readers the various notions which have been entertained by the ancients from the time of Herodotus down to that of

Hunter ; but were I to do so, an introductory volume would be necessary ; this, however, was not the plan I thought desirable to adopt ; my object being, in as concise a manner as possible, to lay before the public, facts that had come under my own observation during a long course of practice, and which I considered would be the most beneficial to the general reader.

The writers which I have selected are considered the principal authorities in the department of Dental Surgery, and their views have been generally entertained by the public. My object, therefore, in selecting them, was a matter of necessity rather than of choice—that I might contrast their views, which had become so popular, with my own, and thus the more forcibly remove erroneous impressions as to the cause of the destruction of the teeth.

The notions which the ancients entertained of the structure of the teeth, the pain occasioned by them, and the cause of their destruction, are for the most part extremely crude and fantastic.

Hippocrates, who lived four hundred and sixty years B. C., says that “there is a glutinous increment from the bones of the head and jaws, of which the fatty part is dried by heat and burnt up, and the teeth are made harder than the other bones, because there is nothing cold in them.” Aristotle was so ignorant of the anatomy of these parts, as to assert that man has more teeth than woman. Pliny, a celebrated Roman naturalist, and Aretæus, a Greek physician of great eminence, who lived about the middle of the first century, or about

four hundred years after Aristotle, assert that the cause of the tooth-ache is only known to God.

Those of my readers who may be desirous of knowing the opinions of the ancients, and also those of most of the English, French, and German writers, I would refer to a work by my friend Mr. Nasmyth, an introductory volume, entitled "Researches on the Development, Structure, and Diseases of the Teeth," published in 1839; and for the same purpose, I would refer them to a review of the second edition of my book, in the Edinburgh Medical and Surgical Journal of January, 1840, where the reviewer has entered fully and ably into a critical analysis of almost all that has been previously written upon the subject. I shall, therefore, confine my remarks in the way of criticism, to the principal writers upon the teeth, and in venturing to point out the erroneous doctrines laid down by these eminent authors on this most important subject, and to bring forward what I consider a correct theory of the nature and cause of caries, or decay of the teeth, I trust I shall obtain credit, when I declare that I undertake the task with considerable deference, and that I am only influenced in opposing such influential authorities, by a strong conviction of the practical importance of the opinions which I have been led to adopt. For, upon a correct knowledge of the causes by which disease of the teeth is engendered, and the true development of the nature of the process by which their destruction is effected, must depend all the rules of treatment, both for the prevention and the timely correction of such disease.

The mistaken notions which have been advanced upon this subject, it is of the more importance to correct, because they suppose the proximate cause of decay to be inflammation of the internal substance of the tooth, commencing, according to the theory of Mr. Bell, upon the surface of the bone, within the enamel; and, according to the doctrine of Mr. Fox, originating in the internal membrane; and consequently, the primary seat of the disease being in the interior of the tooth, it does not discover itself externally, until it has made considerable ravages in the internal substance of the organ; an error of the greater consequence, because it leads the public in general, to whom the influence of the opinions of eminent men naturally extends, to neglect the teeth during the first stages of decay, when its progress might be arrested, and to withhold their attention until acute suffering and irremediable mischief have been produced.

The views which I have been induced to take of this subject, from a long course of practice and observation, are of a nature altogether different from those above alluded to; and I feel assured that the evidence which I shall be enabled to produce in the following pages, will satisfactorily prove the disease in question to have an origin entirely different from, and a progress diametrically opposite to, those insisted upon by the authors before mentioned; and should I succeed in establishing my opinions, they will necessarily lead to consequences of the first importance, by showing the possibility, with proper care and timely attention, of permanently arresting the disease during its first

stages, and before the vital parts of the tooth have been exposed, and inflammation consequently excited ; an object which the doctrines hitherto inculcated could not embrace, because they assume extensive mischief to have taken place before any visible signs of it are discoverable.

Before stating my own views, I shall first notice the theories which have been advanced by the two principal writers on the diseases of the teeth, and make a few observations upon them ; but before doing so, in order that I may be clearly understood, it will be necessary to give a short description of the structure, organization, and arrangement of the teeth.

CHAPTER I.

STRUCTURE, ORGANIZATION, AND ARRANGEMENT OF THE TEETH.

A TOOTH consists of two parts, one of which is called "enamel," and is composed almost altogether of the phosphate of lime; that part of the tooth which is exposed, and which is named the "crown" (Plate IV., fig. 5, *a*,) of the tooth, is covered over with this dense substance. The other part, consisting of the fang, (Plate IV., fig. 5, *c*,) which is embedded in the socket, and the body (Plate IV., fig. 9, *c*,) of the tooth contained within the enamel, is different in character from other bones; it contains more of the phosphate of lime and less of animal matter, and is consequently more dense and compact in its structure. The enamel is complete at the period when the tooth appears above the gum, and no addition takes place afterwards, as erroneously supposed by some persons. It is quite the reverse with the bony portion; for at this period, the fangs are very imperfect in their formation, the openings at their points where the nerves and blood vessels enter, and the ducts through which they pass, are large, (Plate IV., fig. 9, *f*, *e*, *d*,) as is also the cavity of the tooth; but a deposition of bone continues until the cavity becomes comparatively small, (Plate IV., fig. 10, *d*, *e*, *f*,) and the same thing goes on within the fangs

until the openings at their points will scarcely admit the smallest needle.

The nerves and arteries which enter the fangs of a tooth, branch out upon a fine membrane that lines the cavity within the tooth; and thus situated they are protected from the influence of foreign bodies by the surrounding bone and enamel.

There is another membrane connected with the tooth, called the “periosteum,” which lines the socket and envelopes the fang. This membrane is also protected from external influence by the firm adhesion of the gums to the necks of the teeth.

A complete set of teeth comprises thirty-two in number, sixteen in each jaw; and they are arranged in the following order, namely,—

Two front *Incisores* or cutting teeth,
Two lateral *Incisores* or cutting teeth,
Two *Cuspidati* or canine teeth,
Four *Bicuspides* or small grinding teeth,
Four *Molares* or large grinding teeth,
Two *Dentes Sapientiæ* or wisdom teeth.

(Plate I., fig. 1, 2.)

This brief description of the structure and arrangement of the teeth will be sufficient for my present purpose. In another part of the work I shall have occasion to describe the mode of formation of the bone of the teeth, and the process by which the enamel is secreted.

CHAPTER II.

THEORIES OF CARIES, ADVANCED BY MR. FOX
AND MR. BELL.

I now proceed to examine the theories advanced by Mr. Fox and Mr. Bell, as explaining the origin and progress of decay in the teeth; and to point out the erroneous views which these authors have taken of this subject.

“The proximate cause of caries,” says Mr. Fox, “appears to be an inflammation in the bone of the crown of the tooth, which, on account of its peculiar structure, terminates in mortification.

“The membrane, which is contained within the cavity of a tooth, is very vascular, and possesses a high degree of nervous sensibility; and inflammation of this membrane is liable to be occasioned by any excitement which produces irregular action; and as the bone of the tooth is very dense, and possesses little living power, a death of some part of it may speedily follow an inflammation of the vessels of the membrane which is contained within the cavity. When this membrane becomes inflamed,” he says,

“it separates from the bone, and the death of the tooth is the consequence.”*

It is evident that Mr. Fox was induced to take this erroneous view of the cause of caries of the teeth by comparing the teeth with other bones, and by supposing that a similarity of structure and organization existed in both. For he goes on to say, “That this is the proximate cause of caries appears to be highly probable, by remarking that a caries of other bones is caused by a separation of those membranes which cover them. Thus a separation of the periosteum will cause a death of the tibia, or that of the pericranium a caries of some part of the bones of the head. This opinion,” he considers, “is confirmed by comparing the symptoms which accompany inflammation in a bone with those which are occasionally felt by persons in their teeth, previously to any appearance of caries.”

According to Mr. Fox’s theory, inflammation of the membrane within the tooth is the original and immediate cause of decay in the tooth. If this were true, we should be subject to tooth-ache, which is nothing more than pain produced by inflammation of the membrane, previously to the commencement of decay. But this doctrine of Mr. Fox’s must be fallacious, for it is contrary to all experience, as every one who has suffered from tooth-ache can testify. I have found, from long practice and observation, the very opposite of this doctrine to be the fact; and in the following

* Fox’s Nat. Hist. of the Teeth, Part II., p. 12.

pages I shall have no difficulty in proving, that the symptoms which Mr. Fox describes are not felt in a tooth before decay has taken place; that decay of the tooth is not occasioned by previous inflammation of the membrane; but, on the contrary, that inflammation of the internal membrane is the result of previous decay in the tooth, not the cause of it; and that decay may be, and constantly is, detected and permanently arrested, when properly attended to, before the membrane of the tooth has become exposed, and consequently before inflammation has become excited.

Moreover, the doctrine promulgated by Mr. Fox, is most dangerous in its consequences, because it has a tendency to mislead the reader by inducing him to believe that, in the absence of pain, his teeth must be in a sound and healthy condition; for he is naturally led to conclude that, if inflammation of the internal membrane be the cause of decay in the tooth, it will be time enough to apply for relief, and to attend to the safety of the tooth, when pain is felt.

In the next chapter I shall have an opportunity of shewing that decay is not the result of inflammation, but of chemical action; that decay commences upon the surface of the tooth, and proceeds gradually to the interior; that it is only after an opening has been made through the walls of the tooth that the membrane becomes exposed and inflamed; and that by waiting until pain occurs, we wait until the tooth is placed beyond the means of remedy.

Mr. Bell, the author of a work before alluded to, entitled, "The Anatomy, Physiology, and Diseases of the Teeth," differs from Mr. Fox in his view of this subject; although, like Mr. Fox, he makes the proximate cause of decay of the teeth to consist in inflammation, but in inflammation of the external surface of the bone, immediately under the enamel. "The true proximate cause," says he, "of dental gangrene (caries) is inflammation; and the following appears to me to be the manner in which it takes place. When, from cold or from any other cause, a tooth becomes inflamed, the part which suffers the most severely is unable, from its possessing comparatively but a small degree of vital power, to recover from the effects of inflammation; and mortification of that part is the consequence.

"The situation in which gangrene invariably makes its first appearance, immediately under the enamel upon the surface of the bone, is, I think, explicable only with the view I have taken of the structure of the teeth, and the nature of this disease. As the vessels and nerves, which supply the bone of the teeth, are principally derived from the internal membrane, it is natural to conclude that, in so dense a structure, the organization would be less perfect in these parts which are farthest removed from its source."*

Now there is one simple and, I think, conclusive argument, both against the theory of Mr. Bell, who

* See Bell on the Diseases of the Teeth, pp. 124, 125.

refers the origin of decay in the teeth to inflammation in their bony structure, and to that of Mr. Fox, who refers it to inflammation of their internal membrane; namely, that as all teeth are furnished with a similar lining membrane, and all are possessed of the same bony structure, they should all, according to these views, be equally subject to the same disease, and no one class of teeth should therefore be more frequently the seat of caries than another; and yet it is a fact universally admitted, and acknowledged by the authors just quoted, that this is not the case.

Is it not a well known fact, observed by every one, that the *dentes sapientiæ*, or wisdom teeth, are more liable to decay than any of the other teeth? If decay be the result of inflammatory action, why should these teeth in particular be so peculiarly predisposed to it? Why should the molar teeth and the bicuspidæ be more liable to decay than the upper incisores? And why should the canine teeth and the lower incisores be the least of all subject to decay? That this is the fact may be observed in nineteen cases out of twenty, by any one who may think proper to examine for himself. These are problems that can never be solved by any theory which is grounded upon inflammatory action.

Mr. Fox, in noticing the greater predisposition to caries in a particular class of teeth, says, "The molares, or large grinding teeth, are more subject to this disease than any other teeth, and the incisores of the upper jaw are very frequently affected by it, whilst the

incisores of the lower jaw very seldom become decayed.”*

Mr. Bell makes a similar observation, and says, “The teeth most liable to mortification are undoubtedly the *dentes sapientiæ*; the first molares are also frequently decayed at an early age; so much so, that it is often necessary to remove those teeth in consequence of severe suffering from tooth-ache, even before many others of the permanent set are perfected. The cuspidati, both superior and inferior, are comparatively seldom the subjects of disease; and the inferior incisores still more rarely.”†

Were we to set aside Mr. Fox’s theory of inflammation and adopt Mr. Bell’s, we should have equally insurmountable difficulties to encounter. Mr. Bell supposes that caries makes its first appearance upon the surface of the bone immediately under the enamel. “As the vessels and nerves,” says he, “are principally derived from the internal membrane, it is natural to conclude that in so dense a structure, the organization would be less perfect in those parts which are farthest removed from its source.”

Now, agreeably to Mr. Bell’s theory, it would also be natural to expect caries to commence upon that part of the tooth where the surface of the bone was the most remote from the internal membrane. But the very reverse of this is the fact; for it so happens, that those parts of the teeth where the surface of the bone is the most remote from the internal membrane

* Fox on the Teeth, Part II., p. 9. † Bell on the Teeth, p. 133.

are the parts the least subject to caries. We have a striking instance of this in the canine teeth. (See Plate IV., fig. 12, 13.) These teeth are seldom affected with caries; and when it does occur, it always begins at the parts marked *a* and *b*, situations which are nearest to the internal membrane; and decay is never found to commence at the point marked *c*, which is the most remote, excepting in cases where the enamel is defective in this spot, which rarely happens.

Mr. Fox has attempted no explanation of these facts; and Mr. Bell has only endeavoured to account for the greater liability to decay in the *dentes sapientiæ*, or wisdom teeth.

“This probably arises,” he remarks, “from their being formed at a later period of life than the other teeth, when the constitution is doubtless in a less favourable state for the production of newly formed parts, than during early infancy, when the process of new formation is going on with rapidity in every part of the system.”*

The statement of Mr. Bell, as to the greater liability to decay in the *dentes sapientiæ*, is perfectly in unison with my own experience; but his attempt to explain it is not satisfactory, and it appears to be inconsistent with other statements made by him. If this liability depended, as Mr. Bell suggests, on their being formed at a later period of life than the other teeth, why should the molar teeth, which are formed in early infancy, and at the period which, according to him,

* Bell, p. 133.

is most favourable to the process of new formation, be so peculiarly disposed to decay?

The same objection which has been made to the proximate cause of decay, as depending on inflammation of the bone, or internal membrane of the tooth, is equally applicable to the supposed exciting causes of the disease; such, for instance, as hot and cold climates, the taking of food at a high or low degree of temperature, the drinking of strong spirituous and fermented liquors, a disordered state of the stomach, a debilitated constitution, etc. If decay in the teeth were occasioned by any of the above-mentioned causes, all the teeth being equally exposed to their operation, they would, in like manner, be equally the subjects of disease.

It must be evident, from the preceding observations, that no satisfactory reason has been assigned for a fact, which is acknowledged by all writers on the subject of caries, however dissimilar their opinions as to its nature; namely, that the different classes of these organs are liable in different degrees to the disease; and it must be equally evident, that no theory which is founded on the internal structure of the teeth, is calculated to explain this anomaly. It is therefore necessary to look to some other source for an explanation of this predisposition; and, accordingly, I purpose to show that it is to chemical and not to inflammatory action that the destruction of the teeth must be attributed; and by taking this view of the subject we shall have no difficulty in satisfactorily accounting for all the peculiarities and seeming anomalies connected with caries of the teeth.

CHAPTER III.

PROOFS THAT THE DESTRUCTION OF THE TEETH
IS EFFECTED BY CHEMICAL AND NOT BY IN-
FLAMMATORY ACTION.

UPON examination it will be found that there are fissures formed in the enamel of the teeth, in consequence of the irregular distribution of that substance upon their surfaces; and that there are also interstices produced by the crowded position of the teeth, and the irregularity of their shape: In these situations particles of food are retained, which undergo a process of decomposition, and acquire the property of corroding, disuniting, and thereby destroying, the earthy and animal substance of which the teeth are composed. That this is the cause of the destruction of the teeth, commonly called "caries," and that it is not the result of inflammation, either in the membrane or the bone of the tooth, will appear obvious from facts which will be produced, and which I have daily witnessed during a long course of practice.

Dr. Sydenham, in the dedication of one of his Treatises to his friend Dr. Mapleton, says, "that the medical art could not be learned so well and so surely as by use and experience; and that he who would pay

the nicest and most accurate attention to the symptoms of distempers, would succeed best in finding out the true means of cure."

The bone and enamel of the teeth are differently constituted from the other parts of the body; they are not formed after the manner of other bones, nor are they governed by the same laws. It is from supposing that a similarity of structure and organization exists in both, and from overlooking the peculiar structure of the teeth as compared with other bones, that erroneous notions relative to the causes of caries of the teeth have been advanced. These misconceptions have naturally led the authors of them to apply terms to the teeth which are usually employed to designate disease in other bones; but it will appear obvious that the terms "caries," "mortification," etc., are not applicable to that process which effects the destruction of the teeth, the mischief being the result of chemical action, and not of inflammation. Nevertheless, as the application of these terms has been so universally sanctioned by custom, it may be as well to retain them, but with a correct knowledge of their signification as applied to the teeth.

I shall first describe the mode of formation of the enamel and bone of the teeth, and show that they are neither formed after the manner of other bones, nor governed by the same laws. In the second place I shall point out the situations where decay first begins upon the teeth; explain the cause why one class of teeth is more subject to decay than another,

and trace the progress of decay up to the period when tooth-ache is produced. And in the third place I shall prove, from various indisputable facts connected with the character of caries of the teeth, and also from the nature of the treatment which is now so generally and successfully employed in arresting its progress, that the views which I have taken of the cause of the destruction of the teeth must be correct; and that the theories which have hitherto been advanced, and which are grounded upon the supposition that decay of the teeth is the result of inflammation, must be fallacious.

In describing the formation of the enamel and bone of the teeth, I shall be enabled to explain the nature and origin of the pits and fissures which are so often formed in the enamel, particularly upon the surfaces of the grinding teeth, and which are the principal cause of their destruction. In this description it will also appear, that the teeth and *organized* bodies bear no resemblance to each other in their mode of formation, but on the contrary, a striking similarity will be perceived between the teeth and *inorganic* bodies in the mode of their formation.

The rudiment of a tooth consists of a soft vascular substance termed the "pulp," whose shape is similar to the body of the tooth to be produced. Ossification first commences upon the cutting edges of the single teeth, and upon the grinding surfaces of the double teeth. When a thin layer of bone has been deposited upon the grinding surface, ossification gradually proceeds down the sides of the pulp, thus forming the

outline of the body of the tooth; and afterwards, the fangs are formed. When the grinding surface is covered with the first layer of bone, a deposition of enamel commences upon the parts of the surface which are the highest, and which will ultimately form the most prominent parts of the crown of the tooth. There will therefore, at the commencement, be several isolated spots of enamel, which will gradually increase in size and in thickness, and at length coalesce so as to constitute a continuous layer over that portion of the tooth which is necessarily to be exposed for the purpose of mastication. In a great majority of cases, however, this perfect union of the several portions of the enamel does not take place. The secreting membrane appears to furnish an abundant supply of enamel up to the very period when the isolated portions of this substance are apparently on the point of uniting; but, exactly at this time, the membrane ceases to furnish the necessary secretion in the situations which would complete the union of the separate portions, the process going on in all the other parts; the consequence of this is, that fissures are formed in the enamel, which, in many instances, extend down to the surface of the bone. See the external appearance of these fissures as they are represented in Plate II., fig. 1, 2. In the same plate, fig. 7, it will be observed that the fissures are not confined to the grinding surfaces of the teeth, but are often to be found on their sides. See also the internal formation of one of these fissures as shown in Plate IV.,

fig. 9, by the cutting of the tooth in a longitudinal direction. In these situations particles of food are retained, and the more liquid portions of it pass down to the surface of the bone beneath the enamel, where it undergoes a process of decomposition, and acquires the property of disuniting and destroying the substance of which the tooth is composed.

It is to this irregularity of structure, so peculiar to the double teeth, that their greater tendency to caries is to be attributed; and the liability of the teeth in different individuals to decay, will be in proportion to the form and depth of these fissures. On the other hand, where there is a close union of the sections of the enamel upon the surfaces of the teeth, as represented in Plate II., fig. 3, there will be no tendency to decay, because no lodgment can take place.

In a drawing, however well the figure may be executed, it is scarcely possible to give a correct idea of the depth and form of the pits and fissures above mentioned. It is of little consequence by what comparison we illustrate, so that our ideas are clearly conveyed to, and impressed upon, the mind of the reader. Every body is familiar with the form and character of that very common and useful vegetable, the blue potatoe; the deep pits which its surface presents, are very similar to those found upon the enamel of a tooth. There are certain kinds of this vegetable which present almost a smooth surface; so also is it with some teeth; but the blue potatoe is full of deep pits, and every kitchen maid knows the difficulty of removing the soil which

lodges in these fissures. It is upon the grinding surfaces of the double teeth that the pits are found the deepest, and although I strongly recommend the use of a firm elastic brush for the purpose of keeping them clean, yet in many instances the brush will not reach the whole depth of these pits, consequently another mode of treatment becomes necessary, as I shall have occasion to explain hereafter.

The enamel is completed, and the secreting membrane removed, previously to the tooth appearing above the gum, so that no after change can take place in the structure of this substance; nor can it be affected by any of the constitutional diseases or changes to which the human body is subject: therefore, the durability of the teeth, or their predisposition to caries, will depend upon the state of the constitution at that early period of life when the enamel is being formed.

The enamel of the teeth is now universally acknowledged to be an inorganic substance, and can only be acted upon chemically; therefore, when a tooth has appeared above the gum, we can readily ascertain whether it is or is not predisposed to caries, by examining the structure of the enamel; and it will be found that the rapidity of the chemical action, and the ultimate destruction of the tooth, will be in proportion to the form of the receptacles that may be found in it, and their capability of retaining more or less of extraneous matter.

We now come to the bone of the teeth; and, upon

examination, we shall find that this substance is not formed after the manner of other bones, nor governed by the same laws. In the mode of its formation, and also in its constitution, it bears a striking similarity to inorganic substances; but in neither does it resemble organized bodies. In a subsequent part of the work, I shall have occasion to enter at some length into the nature of the character and constitution of the bone of the teeth as compared with other bones, when I trust I shall be able satisfactorily to prove, that the bone of the teeth is not subject to inflammation, and that any theory which is founded upon this supposition must be erroneous.

In organized bodies, the outline of each part, and of the whole, is first sketched, and then their completion is effected by successive depositions taking place from circumference to centre. On the contrary, the growth of inorganic bodies begins with a nucleus, and becomes enlarged by the deposition of layers upon its surface. We find that the bone of a tooth bears a more striking resemblance to the latter formation than to the former; the bone of the tooth being formed by depositions of layers after the manner of inorganic bodies, and not like other bones, by depositions from circumference to centre.

We have first the pulp, a soft vascular substance, similar in shape to the body of the tooth to be produced, and upon this mould the bone of the tooth is formed. The first part that is formed of a tooth is its masti-

eating surface, and when this has been accomplished, the investing membrane begins to deposit enamel upon the external surface of this thin layer of bone which crowns the pulp of the tooth. We have now two operations going on, the external membrane secreting enamel on the outer surface, and the pulp or internal membrane depositing bone on the inner surface; one layer of new bone after another is added to that which was first formed, gradually thickening the grinding surface, and extending down the sides of the pulp, thus forming the complete outline of the body of the tooth; and by a continuation of the same process the fangs are formed.

The pulp of the tooth has now enclosed itself in a shell of bone, with the exception of an opening at the point of each fang, similar in shape to the opening in a quill when its point is cut off. The tooth has at this period attained to its full size externally, that is, by measurement, taking the length and girth of its body and fangs; but, perhaps, there is not more than two parts of the bone formed internally; for the tooth within is very hollow, and the openings into the fangs large.

At this stage, and previously to the tooth appearing above the gum, the enamel has been completed, and the membrane which secreted this substance has been removed; so that there can only be one opinion regarding the inorganic nature of the enamel; for it is obvious that nourishment cannot be derived from a membrane after it has ceased to exist. On the other hand, we see

a sufficient reason why the internal membrane should be retained; for at the period when the tooth has appeared above the gum, and the enamel has been completed, a third part of the office of the membrane which secretes the bone remains to be completed; and for this purpose it is retained. But there is not the slightest reason to conclude, because this is the case, that its presence is necessary for the nourishment of that portion of the bone which has already been formed.

I consider the sole office of the vascular membrane lining the cavity of a tooth, to be the secretion of bone; and this arrangement appears to be a wise provision of Nature; for by the process of mastication, the enamel at the surface is gradually worn down, and the bony structure itself becomes at length exposed, and is also ground away. If no provision were made as a supply against this wasting action, the cavity of the tooth would soon be laid open. But to guard against this, additional bone is slowly but unceasingly deposited within, by the lining membrane; and, as is well known, the cavity of the tooth is gradually diminished in capacity, until in old age it is nearly obliterated.

It is a singular circumstance that the rapidity of this secretion depends upon, and is regulated by, the demand made for its utility; for we often find, in the middle periods of life, that the teeth are very much worn down by friction, and when this is the case, I have always observed that the internal membrane has

been very active in secreting bone internally, to remedy the deficiency. To supply this additional bone, appears to be the only function of the membrane lining the cavity of a tooth; and this opinion is supported by facts which we obtain from comparative anatomy.

In the case of the hippopotamus, and other *rodentia*, the teeth are quickly ground away by the great degree of attrition which their food requires, and would soon be completely destroyed, did not the vascular pulp or membrane within these organs supply new bone as rapidly as it is worn off externally; and it may be observed also, that in these animals the bone is very soon brought into action. "Is it at all probable that a vascular and sensible part should be destined to perform the trituration of the different hard bodies which constitute our food, and be exposed to the mechanical attrition which this office must necessarily occasion?"*

* Article, "Cranium," Rees' Cyclopædia.

CHAPTER IV.

PREDISPOSING CAUSES OF CARIES TO BE DISCOVERED IN THE EXTERNAL FORM, CONFIGURATION, AND JUXTA-POSITION OF THE TEETH.

I NOW proceed to point out the situations where decay commences upon the teeth, and to explain the cause why one class of these organs is more subject to decay than another. In doing this I shall review the several divisions in the order of their liability to decay; and consequently, the first that claim our attention are the molares, including the *dentes sapientiæ*, which, from the circumstance of their appearing at a period of life subsequent to the formation of all the other teeth, are frequently considered as a separate class; yet they undoubtedly belong, as shown by their structure, to the molar division of the teeth.

It has before been admitted that these are more subject to decay than even the molar teeth; but the aptitude arises from a different cause, which will be afterwards explained. For the present I shall include them with the molar teeth, because they are similarly constructed, and on that account are equally liable to decay.

The molar teeth are much larger than any of the other teeth, (Plate I., fig. 1, 2, *e, e, e, e,*) their grinding surfaces are broad, and present an irregular cavity, bounded by an elevated and uneven ridge. This surface is often intersected with numerous smaller projections or ridges, running transversely and in various directions, and corresponding with an equal number of depressions, which constitute so many smaller cavities or deep pits; occasionally a fissure extends across the ridge of the masticating surface, and forms a cavity in the side of the tooth; (Plate II., fig. 1, *d, e,* and fig. 7, *q, r;*) in other cases the masticating surface presents three or four prominences around a deep pit in the centre. (Plate II., fig. 1, 2, *a, f, h.*) These indentations are in size, depth, and number, infinitely variable, so much so, that we rarely meet with two molar teeth exactly alike, with the exception of the corresponding teeth of the same jaw, in which we always find a great similarity of structure.

The liability to caries in the class of teeth now under our notice, which, as before asserted, are of all the teeth, most frequently affected with it, will be found exactly to coincide with the irregularity of their surfaces as just described, and particularly with the depth of their indentations. Accordingly the masticating surfaces, in which the deepest depressions are met with, are in the great majority of cases the seat of decay, and the first to be affected with it; and the part of these sur-

faces in which decay is always found to originate, is the bottom of one or more of the deepest indentations.

The next class of teeth most liable to decay are the bicuspidæ of the upper jaw; (Plate I., fig. 1, *d, d;*) their grinding surfaces are much smaller than those of the molar teeth, and consist of an anterior and posterior eminence, with an intermediate chasm open to its extremities, and not, as in the case of the molares, shut in by lateral prominences, thereby producing a hollow cavity or pit. These teeth are not subject to decay in the situation above described, except in occasional instances, where these fissures are found to be deep and irregular. On the other hand, the bicuspid is principally, and perhaps more than any other, affected with caries on its sides, as from the thickest part of the crown downwards it becomes suddenly flat and contracted, so as to form a neck or groove immediately below that point where it comes in apposition with the contiguous tooth. (Plate II., fig. 5, 6, *l, m, n.*) In this situation we find decay to commence.

The next in order of liability to the disease are the incisores of the upper jaw. The surfaces of these teeth are broad, the anterior being smooth and convex, the posterior, on the contrary, being rather uneven and concave; the broadest parts of these teeth are their cutting edges, where they are placed in apposition with each other; from this part which

is thin and smooth, they gradually increase in thickness towards their fangs, so as to represent the form of a wedge; from the same point, and in the same direction, they diminish still more considerably in width, so that their roots diverge from each other, and thereby leave interstices (Plate III., fig. 2, 4.) or openings between them. Decay is never found upon the cutting edges of the incisores, nor is it found upon their plain convex surfaces, excepting where there is some defect (Plate IV., fig. 2, 3, 4) in the formation of the enamel; and on their posterior surfaces, we only meet with it when they are deeply indented, (Plate IV., fig. 1, *b*, *b*.) which is rarely the case. The situation where decay takes place in these teeth is at their sides, (Plate III., fig. 2, 4,) immediately above the points where they unite with each other.

The incisores of the lower jaw are less subject to decay than any of the other teeth. They are more regular and uniform in their shape, and their fangs are thicker in proportion to their bodies than those of the upper jaw; consequently, they do not present necks and interstices of the same kind. (Plate III., fig. 7. 8.) For the same reason, the remaining class, the cuspidati, or canine teeth, are comparatively little subject to decay, particularly those of the lower jaw; but there is another reason why the incisores and canine teeth of the lower jaw are less subject to decay than any other teeth. The saliva having a natural tendency to occupy the lower

part of the mouth, the teeth there placed, are constantly bathed with this fluid, which, by its property of dissolving the particles of food, is in a greater degree calculated to remove them; or, by its decidedly antiseptic qualities, prevents the process of putrefaction. Moreover, the interstices of these teeth being frequently filled up with an earthy substance, called "tartar," deposited from the saliva, they are consequently not liable to lodgments of food; and accordingly these teeth, when they are lost, seldom perish from decay, but fall out from the absorption of the gums and sockets, occasioned by this calcareous concretion.

The next thing to be considered, and the only thing left unnoticed, relating to the structure or position of the teeth, as far as this inquiry is concerned, is a peculiarity connected with the *dentes sapientiæ*, or wisdom teeth, the consideration of which was before purposely deferred. It has been admitted that they are more liable to decay than any of the other teeth, and this liability arises not only from their indented surfaces, which have been already described with the molar teeth, but also from another cause peculiar to themselves. These teeth come at a later period of life than the others; they rarely begin to appear before the age of eighteen or twenty, and often much later than that; whereas the other teeth, amounting to twenty eight in number, are completed, and have taken up their stations at the early age of ten or twelve years, and generally

fill up the whole extent of the jaw, so as to leave but little space for the *dentés sapientiæ*; the consequence of which is, that when these are prepared to emerge through the gum, their progress is slow on account of their confined situation. When the one half of the surface of the tooth has made its appearance through the gum, the other half continues for a considerable period of time covered, thus forming a recess between the concave and pitted surface of the tooth and the overlapping gum. (Plate I., fig. 1, 2, g, g.) It is in this situation that decay, which is so frequent in these teeth, is found to commence, and in many instances to have made considerable progress, before the whole surface of the tooth has risen above the gum.

From the review we have just taken of decay in the different classes of the teeth, it will be perceived that, in regard to situation, it takes place on the surfaces of the teeth, in excavations formed between them and the projecting gum, in cavities, indentations, and irregularities on the external substance of the tooth itself, and that it occurs at their sides, in their necks, and in the spaces produced by their formation and relative position; in regard to frequency, that it is in proportion to the depth of the superficial depressions, and the degree and nature of the lateral projections and interstices.

This being the case, and decay never being found to commence upon the plain and smooth surface of the tooth, it cannot for a moment be doubted, that

the predisposition to caries depends upon the external configuration or conformation of the teeth. It must be equally evident from the partial nature of the disease, and from the insufficiency of all general causes, as before pointed out, to explain its origin, that the exciting cause of caries must be one whose operation is partial, and having a peculiar action upon those parts of the teeth, which are by their structure predisposed to decay. The only cause of the partial operation and the particular situations of decay, is the corrosive or chemical action of the solid particles of the food which have been retained and undergone a process of putrefaction or fermentation in the several parts of the teeth best adapted for their lodgment.

CHAPTER V.

LIABILITY OF THE TEETH IN GENERAL TO DECAY
IN PAIRS—THE RARE OCCURRENCE OF DECAY
OF THE TEETH IN THE AFTER PERIODS OF LIFE,
AS COMPARED WITH ITS FREQUENCY IN YOUTH
—THE GREAT SUSCEPTIBILITY TO CARIES IN
THE TEETH OF PARTICULAR FAMILIES—THESE
FACTS ACCOUNTED FOR AND EXPLAINED.

THE explanation just offered, will be found to apply to all other facts connected with the history of caries, as given by different authors; such for instance as the liability of the teeth in general to decay in pairs; the rare occurrence of decay after the age of fifty, as compared with its frequency in the early periods of life; the great susceptibility to caries in the teeth of particular families. In reference to the first of these facts, Mr. Hunter says: "Decay of the teeth does not seem to be so entirely the effect of accident as might be imagined; for it sometimes takes place in them by pairs, in which case we may suppose it owing to an original cause, coming into action at its stated time; the corresponding teeth being in pairs, with respect to the disease, as well as to situation, shape, etc."

"This opinion," he states, "is somewhat strengthened by the fore teeth in the lower jaw not being

so subject to decay as those in the upper, although equally liable to all accidents arising from external influence, which could produce the disease in general. The fore teeth in the lower jaw appear to be less subject to this disease than any of the others; the fore teeth in the upper jaw, and the grinders in both, are of course more frequently affected.”*

It is truly extraordinary that Mr. Hunter, whose attention, as shown by the passage just quoted, was so particularly drawn to the correspondence in shape and situation of the pairs of teeth which so frequently decay together, should not have immediately perceived that the coincidence of decay was the necessary result of the correspondence of formation. If this had occurred to his mind, and with such strong evidence before him, it is wonderful that it escaped his penetration, he would not have had recourse to the vague and unsatisfactory supposition of some unknown “original cause coming into action at its stated time,” but would have seen that the corresponding teeth have the same aptitude for retaining particles of food;—that the parts of the teeth where decay has its seat are the deep indentations or angles where the food is deposited;—that the disease takes place in both these teeth in precisely the same situations, and that consequently they are similarly liable to decay because they are similarly constructed.

The oversight of Mr. Hunter is perhaps the more astonishing, as he was inclined to suspect that, during

* Hunter's Nat. Hist. of the Teeth, Part II., page 7.

life, there is some operation going on which produces a change in the diseased part. "The most common disease," says he, "to which the teeth are exposed, in such a decay as would appear to deserve the name of mortification. But there is something more; for the simple death of the part would produce but little effect, as we find that teeth are not subject to putrefaction after death; and therefore I am apt to suspect that, during life, there is some operation going on which produces a change in the diseased part. It almost always begins externally in a small part of the body of the tooth."*

We have seen that Mr. Hunter has left the cause of the liability of the teeth to decay in pairs undefined; and the only explanation suggested by Mr. Fox, which is altogether gratuitous and far from satisfactory, is "that they acquire this disposition to decay from some want of healthy action during their formation."† Mr. Bell explains this fact on the same principle as Mr. Fox, which principle we have before seen him apply with so little success to explain the frequency of decay in the *dentes sapientiæ*.‡

The next fact to be noticed is the rare occurrence of decay in the teeth after the age of fifty, as compared with its frequency in the early periods of life. "This disease and its consequences," says Mr. Hunter, "seem to be peculiar to youth and middle age. The shedding teeth are as subject to it, if not more so,

* Hunter, Part II., page 1.

† Fox, Part II., page 16.

‡ Bell, page 129.

than those intended to last through life;* and we seldom or never see a person whose teeth begin to rot after the age of fifty years. This might be supposed to arise from the disproportion that the number of teeth after fifty bear to them before it; but the number of diseased teeth after fifty do not bear the same proportion.”† This statement is also in accordance with my own experience; and although it has not been accounted for by Mr. Hunter, or the other writers on this subject, it can readily be explained on the principle insisted upon in this treatise.

It has before been shown that the grinding teeth are most liable to caries in consequence of their deeply indented surfaces. In early life, when the teeth appear above the gums, we must remember that the enamel is completed, and that it undergoes no after change. If the enamel be then defective in its formation, if the different sections of this substance be not closely united upon the surface of the tooth, pits and fissures will present themselves calculated to retain particles of food; consequently the operation of decay would immediately commence, and the loss of those teeth in early life would be the result. On the other hand, it may be safely presumed that the surfaces of such teeth as remain sound to the advanced period alluded to by Mr. Hunter, never were deeply indented, (Plate II., fig. 3,) or they would not have escaped

* Mr. Hunter is mistaken in this observation; the temporary teeth are not so liable to decay as the permanent teeth.

† Hunter, Part II., page 7.

decay; but having escaped it, they are, in every succeeding stage of life, less and less disposed to the effects of this disease; for we generally find, that at the age of fifty the surfaces of the teeth are worn down, (Plate II., fig. 4,) and become smooth from a long course of mastication; and when decay does occur, it is principally confined to the sides of the teeth, (Plate II., fig. 6,) and is occasioned by a lodgment of food in the interstices produced by a receding of the gums.

In the early periods of life too, the progress of decay is more rapid in effecting the destruction of the teeth, because the cavity of the tooth being larger, and the wall of bone between the cavity and enamel consequently thinner, the decay has a shorter distance to penetrate before it accomplishes the exposure of the internal membrane; whereas, in the middle and later stages of life, the bony partition becomes considerably thickened, so as to increase the distance between the surface of the tooth and the cavity.

If the doctrine insisted upon by Mr. Bell were correct, the teeth would be more liable to decay at the advanced age above alluded to than during the earlier stages; for at that period a filling up of bone has taken place within the tooth, thereby lessening the internal cavity and increasing the distance (Plate IV., fig. 7, 10) between the external surface of the bone and the centre of its circulation. But as this is not the case, Mr. Bell's notions regarding the primary cause of decay must be fallacious; and, moreover, we

constantly find decay to commence in the depressions and irregularities of the teeth, in situations the nearest to, (Plate IV., fig. 13, *b*,) and not the most remote from, the centre of their circulation.

The next fact under this head to be explained, is the great susceptibility to caries in the teeth of particular families; and it is a remarkable circumstance, that there is no feature in which the different members of a family bear so striking a resemblance to each other as in the formation of the teeth; this similarity may, upon minute observation, be always perceived, even when there is nothing particularly conspicuous in the formation or position of the teeth. But when the teeth are of a large size, crowded and irregular from the want of expansion in the jaw, defective in the formation of the enamel, or indeed presenting any other peculiarity, the resemblance which the teeth of children bear to those of one or other of the parents is very obvious; and the similarity is equally great in the indentations and fissures upon the surfaces of the grinding teeth, and also in the depressions and necks in the interstices between them. I have likewise found, when a predisposition to caries exists in the teeth of a family, that decay generally commences upon the same teeth, and in similar indentations and interstices, in the different individuals of the family; and this circumstance alone is a strong corroboration of the principle which I have maintained in the former part of this treatise.

Mr. Bell particularly alludes to this hereditary predisposition of the teeth to caries, and perfectly

agrees with me in describing the facts; but differs entirely in assigning their cause. "It often happens," says Mr. Bell, "that this tendency exists in either the whole or greater part of a family of children, where one of the parents had been similarly affected; and this is true to so great an extent, that I have very commonly seen the same tooth, and even the same part of the tooth, affected in several individuals of the family, and at about the same age. In other instances, where there are many children, amongst whom there exists a distinct division into two portions, some resembling the father, and others the mother, in features and constitution, I have observed a corresponding difference in the teeth, both as it regards their form and texture, and their tendency to decay."*

Here Mr. Bell most explicitly confirms what I have stated as to the hereditary resemblance and hereditary decay of the teeth; and after having observed this similarity of formation, and that decay commonly begins in the same tooth, and even in the same part of the tooth, in several individuals of a family, and at about the same age, he omits to notice the only adequate and satisfactory cause, by overlooking the peculiar formation of that part of the tooth where decay first commences; and in order to account for this hereditary predisposition, he again resorts to the improbable theory of an internal and undefined constitutional cause, occurring during the formation of the teeth, and producing in them a disposition to decay.

* Bell, page 128.

In concluding my notice and explanation of the facts to which our attention has just been directed, and from which Mr. Hunter, Mr. Fox, and Mr. Bell have been led to ascribe the predisposition to caries in particular teeth and families, and at certain periods of life, to “a disease arising originally in the tooth itself,” as Mr. Hunter has indefinitely called it, or to some want of healthy action during its formation, as Mr. Fox and Mr. Bell have supposed; I may further remark, with regard to the cause and primary seat of the disease, which all these writers, on the suppositions above named, have concluded to be one originating in the tooth itself, that Mr. Hunter, who was the earliest writer of any authority on the subject, approached much nearer to the discovery of the origin of the decay, although he has left the nature of it undefined, than either of the other authors, who, principally on the facts and conclusions of Mr. Hunter, have severally proposed a theory of the disease as before stated. In doing this, however, they have not only deviated farther from the true source of the malady, but in many instances have evidently misunderstood the tendency of Mr. Hunter’s observations.

Mr. Hunter remarks that the disease begins externally in a small part of the tooth; that it appears to deserve the name of mortification, but that there is something more,—some operation going on which produces a change in the diseased part. He also observed, that the teeth were subject to decay in pairs, and that the pairs correspond in situation and

shape; and he admits the greater liability to decay in particular classes of teeth, and lastly, remarks, "If it had been always in the inside of the cavity, it might have been supposed to be owing to a deficiency of nourishment in the vascular system; but, as decay begins most commonly externally, in a part where the teeth in a sound state receive little or no nourishment, we cannot refer it to that cause."* He then directs his attention to external injuries, and to menstrua, which have the power of dissolving part of a tooth; but, in doing so, it is evident that the only menstrua which occurred to his mind were those of a transitory kind; namely, the food acting upon the teeth during the short period it remains in the mouth on its way to the stomach. Perceiving that this could not act so partially, he leaves the origin of decay undetermined, and concludes by supposing that it is a disease arising originally in the tooth itself.

Had Mr. Hunter, in looking for an explanation of the disease in the action of menstrua, considered that, besides the food, which is transient in its passage, and the operation of which upon the teeth is general and equal, there are portions of it which are liable to be retained in particular parts of those organs, and which, by remaining there for a time, acquire by putrefaction the property of corroding them, he would have discovered the menstrua which he wanted, and which would have removed all the

* Hunter, Part II., page 8.

difficulties, and accounted for all the facts which he has so ably described. He would have seen at once why decay occurs externally in a small portion of a tooth, in particular parts of it, and more frequently in one class of teeth than in another; he would have perceived in what way their shape and situation concurred in the production of the disease, and why it was so common to particular families and to certain periods of life; and finally, he would have discovered the nature of the morbid process constituting decay, which he has left in uncertainty; and he would not have concluded, as he has done, that the only cause which has a partial operation on the teeth is a spontaneous disease, but would have seen that it is entirely the result of external agency.

Mr. Fox expresses surprise that "although Mr. Hunter went so far, he gave no correct idea of the manner in which the disease can alone originate." But in this observation, Mr. Fox appears to have forgotten the general character of Mr. Hunter, and his aversion to generalize. It is more astonishing that Mr. Fox, with Mr. Hunter's observations before him, and his own opportunities for practical information, should not have perceived that the theory which he has brought forward to supply the deficiency of Mr. Hunter, is not only at variance with the statements of this author, but contrary to experience; for, as we have before observed, if inflammation in the internal membrane of the tooth were the original and immediate cause of decay, we should be subject to toothache

previous to the commencement of decay; the reverse of which is known not only to every practitioner, but almost to every one who has suffered from this disease.

CHAPTER VI.

DESCRIPTION OF THE PROGRESS OF CARIES
THROUGH ITS DIFFERENT STAGES TO THE
PERIOD WHEN TOOTHACHE IS PRODUCED.

HAVING stated what I consider to be the primary cause of caries in the teeth, and pointed out the situations where decay first begins, I shall now endeavour to describe the progress of the disease through its different stages up to the period when toothache is produced. When decay commences upon the surface of a grinding tooth the corrosive action is confined to one or more of its deepest indentations, and may be discovered by a brown discoloration of the part, which discoloration is produced by a chemical action of the food lodging in that situation; and as this action proceeds and increases, the bottom of the indentation becomes black and corroded, and soon afterwards (by the application of a pointed instrument) a small opening may be discovered through the enamel.* When the putrid substance has been admitted through this orifice to the softer bone within the

* Upon sawing, in a longitudinal direction, through a deeply indented tooth, the fissure will often be found to extend to the surface of the bone within the enamel, even in the healthy state.—See Plate IV., fig. 8, *b*.

enamel, decomposition in this situation proceeds with much greater rapidity, whereas the opening through the enamel increases but little, its texture being better able to resist the effects of the chemical action, on account of its greater density; but when decay has proceeded so far as to make an excavation, by the destruction of a considerable portion of the bone under the enamel, the support being removed, the enamel suddenly breaks in during mastication, and a cavity is laid open which, till this period, was not suspected, in consequence of the smallness of the orifice, and the destruction of the tooth, up to this stage of decay, being unaccompanied with pain. At this period, or soon afterwards, by the continued operation of the same chemical action, the internal membrane that lines the cavity of the tooth becomes exposed, and consequently inflammation occurs, the pain produced by which is—toothache.

The description of the progress of decay above given, will equally apply to the disease in whatever situation it occurs, with this difference, that in the interstices of the teeth it is not so easily detected in its first stages, and is seldom found out before an excavation has been made, and a portion of the enamel is broken off. This is more particularly the case with the molares and bicuspidés, whose adjoining surfaces are deeper, (particularly those of the molares,) and consequently the seat of the disease is more concealed from view; whereas the lateral surface of the incisors being thinner, the early stage of caries in them is readily discovered.

It is evident that Mr. Fox and other writers upon the subject of caries, who have supposed the primary seat of the disease to be in the interior of the tooth, have fallen into this error in consequence of having overlooked the small external aperture in the enamel, the original cause of the mischief, where the chemical action commenced and extended to the internal structure of the tooth.

But such, unfortunately, is the insidious character of caries of the teeth, that during its first stages no pain is produced; and so unacquainted are the generality of people with its nature and progress, that application is rarely made for assistance until it is too late to be effectual. This false security, which is so common among mankind, arises from a prevailing prejudice that, as in the other organs of the body, so in the teeth, disease cannot commence without pain. This impression is so generally true, with respect to the diseases of most of the internal organs, whose functions being immediately necessary to life and health, cannot be deranged without uneasiness and suffering, and also to most of the external parts, which being endued with extreme sensibility, the slightest and most superficial injury causes acute pain, that it has become a received principle with respect to the diseases of all parts of the system.

Persons are either ignorant of the fact, or they do not consider, that the enamel of a tooth is an inorganic substance, and perfectly insensible, and that the bony

structure beneath is so void of feeling that the destruction of it is effected without pain or suffering. And further, they are so universally led to believe that decay originates in the internal structure of the tooth, and that the exciting causes operate by inducing some internal morbid process, commencing with inflammation of the membrane or of the bony substance of the organ, that they have never suspected the true cause to be a chemical agent acting upon the external crust and material substance of the tooth itself.

The consequence of these misconceptions is, that the practitioner is hardly ever consulted before pain has been experienced; and, in not a few instances, it is a subject of surprise to the patient when told that the disease is irremediable, and that the only resource is the extraction of the tooth.

When the insidious character of the process of caries, and the true nature of the cause of the destruction of the teeth, become more generally known and correctly understood, the propriety will be seen of that attention to the teeth which I shall have shortly to recommend, and by which alone the progress of decay can be arrested, and the necessity prevented of having recourse to the painful and disagreeable operation of extraction, now so frequently required. Indeed I may boldly assert, that in nineteen cases out of twenty in which the teeth are lost from the effects of caries, this evil might have been prevented, and the teeth permanently saved by the adoption of timely and proper treatment.

Persons are accustomed to consult the dentist, for the same reason that they do the physician or the surgeon, to be relieved from pain. It is true that the object of the physician or the surgeon is to cure disease; the object of the dentist is, or rather ought to be, to prevent disease. But as long as the true nature of the process of caries is misunderstood, the application to the dentist will not, in a great majority of cases, be made till the occurrence of pain compels the attention of the patient to the subject. The mischief, as I have before said, will then be found to be irreparable, and the only resource will be the extraction of the decayed tooth.

I am well aware how natural it is to infer that so long as the teeth are free from pain, they must be in a sound and healthy condition; and, in consequence of such an opinion, to withhold attention from them till they become troublesome. This indeed is the system constantly acted upon, and from want of knowledge on the subject arises all the evil; but my object in this treatise is to show the fallacy of this imaginary security, to point out the danger of waiting till pain occurs, and to urge the necessity of applying to the dentist, so that he may arrest the progress of the chemical action of the decomposed particles of food on the enamel and bone, before the cavity of the tooth is laid open, and the vascular and delicate membrane within exposed.

CHAPTER VII.

THE NATURE OF THE OPERATIONS WHICH ARE PERFORMED UPON THE TEETH, AND WHICH ARE ATTENDED WITH SO MUCH SUCCESS IN PRESERVING THEM, ARE STRONG PROOFS THAT THE DESTRUCTION OF THESE ORGANS IS THE RESULT OF CHEMICAL ACTION.

I SHALL now lay before the reader various facts connected with the character of caries, examine into the nature of the treatment which is now so generally and so successfully employed in arresting its progress; and from these facts I shall prove, that the teeth are destroyed by chemical action, and show that the theories which have hitherto been advanced and grounded upon the supposition that decay of the teeth is the result of inflammatory action, must be incorrect.

That bones are highly organized and liable to inflammation, and that they occasionally become carious, is a well known fact; but it will be readily admitted that decay in bones is a rare occurrence compared with its frequency in the teeth; for where it occurs once in the former, it takes place a million of times in the latter; and yet the destruction of both has been attributed to the same cause.

From our knowledge of the laws of the animal economy, we know, that the parts of the body which are the most highly organized are the most subject to inflammation; and were we to admit the bone of the tooth to be an organized body, and, agreeably to Mr. Bell's theory, an organization of the lowest grade, still we should be led to expect that the tendency to inflammation in the bone of the teeth would be less, not greater, than in other bones.

As regards Mr. Fox's notions of the exciting cause of caries, it must appear evident to every one that he was in error, in supposing that inflammation of the internal membrane of the tooth preceded and led to decay in the bone; for it is obvious that we cannot have inflammation of the internal membrane, without at the same time experiencing that pain which always accompanies inflammation; consequently this pain would compel the sufferer to have recourse to the dentist for relief previously to the commencement of decay, and the only relief would be by the removal of the tooth. Now this is a circumstance which never happens; indeed it is contrary to all experience, for every body knows that decay has made considerable progress before the commencement of toothache.

During a long course of extensive practice, I have not met with a single instance of inflammation of the internal membrane, where the tooth was free from decay. But I have found the very opposite of this to be the fact, namely, that the first stage of

decay is unaccompanied with pain; that decay proceeds to its second and third stage without pain; and I have found that so long as the decay is confined to the enamel and bone of the tooth, and a thin partition of sound bone remains to protect the membrane from the influence of foreign bodies, no pain is produced. It is only when this wall has been broken through, and the membrane has become exposed to external agency, that inflammation is excited, and consequently pain produced.

And here I would remark, that inflammation of the periosteum of a tooth, is not to be confounded with, or mistaken for, inflammation of the internal membrane; for the periosteum, that is, the membrane which lines the socket and envelopes the fang, often becomes inflamed, and the tooth in many instances, from this cause, must necessarily be removed in the absence of decay; but inflammation of the periosteum never occasions decay of the tooth.

The authors who have founded their theories upon inflammatory action, cannot advance a step without encountering insurmountable difficulties; they acknowledge, what must be admitted by every one who has given any attention to the subject, that all the teeth are not in the same degree liable to caries, and they also admit that the structure and organization of all the teeth are the same; but they cannot possibly explain why one class of the same set of teeth are so much more subject to decay than another.

Is it not a fact commonly observed that the *dentes*

sapientiæ are more liable to decay than any of the other teeth? It is a common saying, that the wisdom teeth are the last to come, and the first to go. If inflammatory action be the cause of decay, why should these teeth in particular be so very much predisposed to inflammation? Why should the molar teeth and the bicuspidæ be more liable to it than the upper incisors? And why should the canine teeth and the lower incisors be the least of all subject to this inflammation? These are questions which never can be solved by any theory which is grounded upon inflammatory action as the cause of decay of the teeth. The same difficulties present themselves, whether the inflammation be supposed to commence in the internal membrane or in the bone of the tooth.

Will those gentlemen, who advocate, that inflammatory action in the bone of the tooth is the cause of caries, and whose theories are grounded upon this supposition, explain how it is that decay *never* attacks the fang of a tooth; that portion which is embedded in the socket, and surrounded by the gum? This question is easy of solution in conformity with the theory which I have advanced, and it will appear obvious to the reader that the fang of the tooth is exempted from caries, because it is embedded in the socket, and protected by the surrounding gum from the influence of foreign bodies; consequently it is not subject to chemical action. This is a fact which every dentist, with the least observation, must be acquainted with, and a circumstance of itself sufficient to prove that my views are correct.

It must also be observed, that it is not a small portion of the bone of the tooth which is thus exempted; for when the gums are in a healthy state, and have not receded from the necks of the teeth, there is more than two parts of the whole of the bone of the tooth covered, and therefore protected from caries.

The fangs of the teeth are a continuation of the same kind of bone as that which is contained within the enamel; and if inflammation were the exciting cause of caries in one portion of the bone of a tooth, so would it also be in the other.

The fang of a tooth becomes subject to decay after it has been exposed, but not otherwise; and so it does also when the crown of the tooth has been destroyed; for, in this case, that part of the fang to which the crown of the tooth was attached, now on a level with the gum, presents a hollow surface; the natural duct of the fang is also laid open, and in this situation a lodgment of decomposed matter takes place. In this way the fangs of the teeth may ultimately be destroyed by caries; but they are always the last to be destroyed, and we never meet with an instance of decay commencing upon the bone of the tooth which is contained within the socket.

If decay first began upon the surface of the bone, immediately under the enamel, as Mr. Bell supposes, we should be able to perceive it during its first or second stage, by the part becoming discoloured, which would show through the enamel, previously to that substance becoming corroded or broken in. But I

have never met with an instance of this kind; on the contrary, where decay has made some progress on the lateral edge of a tooth, so as to discolour and partially to corrode it, I have been able to remove the discoloured portion with a file, without penetrating through the whole thickness of the enamel. This is a case of every day occurrence, and it is one which clearly proves that decay does not commence internally; otherwise, the filing of the surface, instead of removing the discoloured part, would make it appear still more conspicuous.

Again, it often happens that decay takes place on the contiguous sides of two teeth, particularly upon the bicuspidæ, when they come in contact with each other at their lateral edges, and diverge towards the gums, so as to adapt them for intercepting food in that situation. The side of one of these teeth is often more liable to be acted upon than the side of the other tooth, in consequence of its having a neck or depression, calculated to retain a greater portion of decomposed food; it will therefore proceed with greater rapidity to that stage of decay in which the membrane becomes exposed and inflamed, so as to render its removal necessary before the other tooth has received much injury. At this period it will be perceived that the side of the remaining tooth has only become blackened; and now that its neighbour is removed, and no resting place left to harbour the putrid substance, decay proceeds no further, and the blackened portion of the enamel continues the same during the life of the individual, with-

out undergoing the slightest change. This is a fact that may constantly be observed by any one who attentively examines the teeth. I have never yet met with an instance of caries in a tooth where the cause could not be traced to chemical action.

As a further proof that inflammatory action is not the cause of decay of the teeth, I would direct the attention of the advocates of this doctrine to the nature of the operations which they themselves, and indeed all experienced practitioners, have recourse to for the purpose of arresting decay of the teeth.

One of the operations to which I allude is the filling of the teeth ; an operation which is well known to be effectual in permanently arresting the progress of decay, when timely and judiciously performed. For instance, when decay begins in one of the fissures which I have pointed out, on the surface of a grinding tooth, the carious portion is entirely removed with instruments adapted for that purpose ; the cavity is wiped perfectly dry, and afterwards filled up firmly with gold leaf, or some other substance which is not liable to corrode ; consequently, the receptacle is done away with, a lodgment of decomposed matter is for the future prevented, and decay proceeds no further.

Is it rational to suppose that this mode of treatment would be successful in subduing inflammation ? From our knowledge of the laws of the animal economy we know that the presence of a foreign substance would only increase the inflammation.

Again: The operation of filing the teeth is also well known to be effectual in arresting the progress of caries. This mode of treatment is had recourse to when decay begins upon the lateral edge of a tooth, and which has been occasioned by a lodgment of decomposed food between it and the adjoining tooth. In this case a separation is made between them with a file, and the operation is continued until the whole of the carious portion is eradicated, and the surface made plain and smooth; consequently the sides of the teeth are no longer capable of retaining decomposed particles of food, the openings between the teeth and the evenness of their lateral edges admit of their being kept perfectly clean, and decay for the future is prevented. If inflammation of the internal membrane, or of the bone of the tooth, were the exciting cause of caries, is it rational to suppose that the removal of the enamel and a portion of the bone of the tooth with a file would subdue inflammation?

Is it not rather a singular and unaccountable circumstance, that one dentist should suppose caries of the teeth to be the result of inflammatory action, and that another should believe it to be the result of chemical action, and yet that both should have recourse to the same means for preventing and remedying the evil? It will be perceived at once that the treatment of the latter is in character and perfectly consistent with the views which he entertains of the cause of caries of the teeth; but that the former, whose views are the very opposite, should have recourse to

the same means,—that he should perform the operations of filling and filing the teeth for the purpose of preventing or subduing inflammatory action, appears very inconsistent and altogether incomprehensible.

The system universally adopted and acknowledged to be beneficial in subduing inflammation in all the other organs of the body is, the abstraction of blood from the vessels leading to the inflamed part; the application of blisters in the neighbourhood of the inflamed part, with the view of withdrawing the serous part of the blood from the contiguous blood vessels; the free administration of active purgatives; the application of warm or cold poultices to the part; and taking sudorific medicines to produce perspiration. These are the remedial measures which ought, consistently, to be recommended by those individuals who suppose decay of the teeth to be the result of inflammatory action; but why they should have recourse to the operations of filling and filing requires explanation.

I might here conclude my remarks on the theory of inflammation of the bone of the teeth; but there are a few other observations which I still wish to make, both as showing its untenable character, and as supporting the view which I take of the inorganic nature of the bone of the teeth.

In order to supply the loss of the natural teeth, the dentist fixes other teeth, either on a gold frame, or on one made from the tooth of the hippopotamus; and this frame, with the teeth so fitted to it, is in a proper

manner inserted in the patient's mouth; but in the fitting and connecting the teeth with the frame the greatest nicety is required; for if any crevice or interval, however small, be allowed to exist between the frame and teeth, a recess will then be made for the reception of minute particles of food, and a process of caries will commence in the extraneous teeth, exactly like that which takes place in the teeth naturally contained in the jaw.

Sometimes the crown of a front tooth is through accident or decay broken off, and it becomes desirable for many reasons that the deformity or defect so produced should be remedied. To accomplish this, the fang of the fractured tooth is filed down to a level with the gum, and the surface is made slightly but regularly concave; the crown of a similar tooth is then to be attached to the fang in the following manner. Its surface, which is to be applied against the fang, is made convex, so as to fit exactly to the concave surface; and the two are held firmly together by means of a gold pin, one end of which is screwed into the crown to be attached, and the other then inserted into the natural orifice of the fang, the nerves and blood vessels within having been previously destroyed. But in this operation, as in the one before described, unless the fitting of these two parts, namely, the extraneous crown and the fang attached to the socket, be so accurately performed as to leave no external aperture or crevice whatever, a place for the lodgment of particles of

food will exist, and a process of caries will speedily occur, which will go on as much in the crown so grafted as in the fang to which such crown is fastened. Surely there can be no tendency to inflammation in the artificial tooth!

From what has been stated, it will be evident to the reader, that the various circumstances connected with caries of the teeth are capable of being explained in strict conformity with the theory which I have advanced. Some of these circumstances are,—the partiality of caries in attacking certain classes of teeth in preference to others;—the *dentes sapientiæ* being those most liable to decay; the molares next in frequency; then the bicuspidæ; and, lastly, the upper incisores; while the canine teeth and incisores of the lower jaw are generally exempt from it;—the liability of the teeth to decay in pairs;—the greater frequency of decay in youth than in the after periods of life;—the hereditary predisposition to it often observed in different families;—the situations where decay takes place, never upon the smooth surfaces of the teeth, but in pits, fissures, and interstices, where the food lodges; the exemption of the fangs of the teeth from decay, so long as they are covered with the gums, and protected from the influence of foreign bodies. All these circumstances are strictly in accordance with my theory, which is, in fact, a legitimate inference deduced from them; whilst the attempts which have been made by various authors to account for them by other causes have signally failed.

The very operations performed in dental surgery lead to, and support, the same view; for the filling up of a cavity produced by caries arrests the progress of the mischief by preventing a further lodgment of food, and the filing out of a decayed part has the same beneficial result, only because it makes the surface of the tooth perfectly plain and unfitted to retain extraneous matter. Moreover, if in artificial teeth, cavities exist in which a lodgment of extraneous substances can take place, a process of caries will commence in them in every respect resembling the caries of the natural teeth.

CHAPTER VIII.

WHY THE HUMAN TEETH ARE SO LIABLE TO DECAY, AND THE TEETH OF THE LOWER ANIMALS ALMOST IN EVERY INSTANCE EXEMPTED FROM IT.

It is a well authenticated fact that the teeth of the lower animals are in almost every instance exempt from disease; and it may therefore be asked,—Why are the human teeth so peculiarly disposed to caries, requiring so much care and watchfulness for their preservation? This peculiar liability to decay in the human teeth I shall be able, I have no doubt, to explain satisfactorily, and in strict accordance with the theory advanced in this treatise.

Both Mr. Fox and Mr. Bell have attributed this predisposition to caries to some peculiarity in the organization of the human teeth; but if we compare the teeth of man with those of other animals the most nearly allied to him in formation, we shall see that the theories hitherto advanced are clearly insufficient to explain this liability to disease in the human teeth alone. An examination of the teeth of apes and monkeys will show a close resemblance in structure, organization, number, and arrangement,

with the same organs in man; the chief if not the only difference being, that in the simiæ, the canine teeth are rather longer or more pointed, with a small interval between them and the lateral incisores.

The temporary set of teeth in these animals amounts to twenty in number, eight of which are molar teeth, and they are succeeded by eight bicuspidates in the permanent set. The same arrangement takes place in the human teeth; the jaws in both instances elongate posteriorly to make room for the permanent molar teeth, and, when completed, the number and classification in both cases are exactly the same.

I have taken repeated opportunities of closely inspecting these organs in many kinds of the simia tribe, and at different periods in the life of these animals, but I have never met with a single instance of a carious tooth in them. This exemption may be readily accounted for, if we take into consideration the structure and arrangement of the teeth of these animals, as compared with the human teeth. Upon examination it will be found that the teeth of these creatures are more perfect in their formation than the human teeth; the enamel is more regularly distributed, the different sections of this substance upon the grinding surfaces of the teeth more closely united, and they do not present fissures similar to those which so generally appear upon the human teeth; consequently they are not subject to decay, because they are incapable of retaining extraneous matter.

The jaw bones of these animals, too, are expansive in proportion to the size of the teeth which are placed in them; there is, therefore, room for the teeth to come in their proper situations, and they are always found to be regular in their arrangement. But this is not the case with the human teeth; in the most contracted jaws we often find the largest teeth; consequently they are forced, for want of room, the one before the other, and heaped in clusters, thus forming receptacles for the retention of decomposed food, which do not exist in a regularly arranged set of teeth. Moreover, the food of monkeys is of a kind the very opposite to that of the human being, and the least likely to be retained in the fissures and interstices of their teeth, did they even exist to the same extent as they do in the human teeth, which is very far from being the case.

The teeth of our common domesticated animals, namely, the horse, cow, sheep, etc., are likewise exempt from caries; and in these instances, as in that of the apes, the food requires so much mastication, that the long continued attrition which it undergoes in order to prepare it for the stomach, serves to keep the teeth themselves perfectly clean.

This greater degree of mastication of the food by other animals, not only prevents a lodgment of particles in the fissures and interstices of the teeth, but also obviates the possibility of tartar being deposited upon them. It is indeed a mistake to suppose that the human teeth are injured by the mere process of mas-

tication, for the very reverse of this is true; and these organs are constantly lost on account of the slight mastication necessary with our food, which is so much softened by our modes of preparing it for the table, as to ensure the retention of some minute portions of it in those parts of the teeth which I have so often described.

It is generally admitted that those of the human race who inhabit warm climates and live chiefly on vegetable diet, are but little liable to caries of the teeth. Attempts have been made to explain this by attributing it principally to the lower temperature at which the food is taken. A little consideration, however, will show the unsatisfactory nature of this explanation; for, in that case, in individuals living under similar circumstances, the liability to caries ought to be general and alike in all the teeth, and not partial, as is acknowledged to be the fact; for the *dentes sapientiæ*, the molar teeth, the bicuspidæ, and the upper incisores, are subject to decay, in different degrees, and decay is of rare occurrence in the lower incisores.

I have had ample opportunities of comparing the teeth of the inhabitants of warm climates, who continue to live in a state of nature, with those of the human race whose habits and mode of living may be said to be artificial; and I have found the teeth of the former much more perfect in the formation of the enamel than those of the latter, which satisfactorily accounts to me for the greater tendency to decay in

the one case than in the other. The teeth of those individuals who live in a state of nature, are not only better formed and less capable of retaining food than the teeth of Europeans, but their diet is of a more simple nature, and a greater degree of mastication is necessary to prepare it for the stomach; and, moreover, the food itself possesses less of those adhesive qualities which it acquires from our more varied and refined modes of preparing it.

I may further observe, that caries does not arise from the solid fibres so frequently retained in the interstices of the teeth, and which simply excite irritation in the gums. At this period, such fibres have not undergone decomposition, consequently, no chemical action is produced on the parts of the teeth with which they are in contact; and it is not till the fibres have become decomposed, and the irritation in the gums produced by their more solid form has ceased, that the chemical action on the teeth commences.

The greater part of the mischief is occasioned by the softer and more adhesive portions of our nutriment, which fill up the irregularities on the surfaces of the teeth, and the openings between them, and afford no evidence to us of their presence; but on that very account, they require to be guarded against with the greatest watchfulness on our part.

I do not consider the disposition to caries to be produced so much by the kind of the food which we take, as by the tenacious character which it

acquires from the modes of cookery which civilization and luxury have introduced.

Having, however, acquired artificial habits in our mode of living, and especially in the preparation of our food, it becomes necessary to employ artificial means to counteract the mischief which might otherwise be produced.

Man, strictly speaking, is the creature of habit and circumstances; his reason and ingenuity enable him to overcome numerous difficulties, to live in all climates, to derive nourishment and support from all kinds of food, and to defend himself against the extremes of heat and cold, and other destructive influences of local situation. But although man exists under many unfavourable circumstances, he is an artificial being, and is deprived of that perfect formation and healthy constitution which animals of the lower creation in a state of nature enjoy. Such animals are confined to the climate and to the locality which are best adapted by nature to supply their wants; and we find the teeth of animals in a state of nature, not only well formed, well arranged, and well adapted for the different kinds of food which they are required to masticate, but we also observe that there is no tendency in the food to injure these organs.

The greater irregularity in the arrangement of the teeth of man also renders them more liable to caries than those of the lower animals; indeed, it may be safely asserted that an irregular distribution, and a

diversity in the indentations and interstices, are met with almost exclusively in the human teeth,* and rarely occur even in those tribes of the human race who still remain in a savage state. I shall leave it to those more extensively acquainted with comparative anatomy and physiology than myself, to account for these facts.

Mr. Lawrence, in his lectures on physiology, zoology, and the natural history of man, observes, that man is the most artificial of all animals, the most exposed to all the circumstances that can act unfavourably upon his frame; that in him diseases are the most numerous, and so abundant and diversified as to exhaust the ingenuity of the nosologist, and fatigue the memory of the physician. Perhaps nosological catalogues would afford the most convincing argument that man has departed from the way of life to which nature had destined him.

The accumulation of numbers in large cities, the noxious effects of impure air, sedentary habits, and unwholesome employments;—the excesses in diet, the luxurious food, the heating drinks, the monstrous mixtures, and the pernicious seasonings, which stimulate and oppress the organs;—the unnatural activity of the great cerebral circulation, excited by the double impulse of our luxurious habits, and undue mental exertions, of the violent passions which agitate

* This irregularity in the arrangement of the teeth is frequently observed in particular breeds of the smaller kinds of dogs.

and exhaust us;—the anxiety, chagrin, and vexation, from which few entirely escape, and their re-acting on and disturbing the whole frame;—the delicacy and sensibility to external influences caused by our heated rooms, warm clothing, inactivity, and other indulgences, are so many fatal proofs that our most grievous ills are our own work, and might be obviated by a more simple and uniform way of life.

The observations of Humbolt, he adds, confirm the position, that individuals, whose bodies are strengthened by healthy habits in respect to food, clothing, exercise, air, etc., are enabled to resist the causes which produce diseases in other men. He points to us the Indians of New Spain as a set of peaceful cultivators, accustomed to uniform nourishment, almost entirely of a vegetable nature, that of their maize and cereal gramina. He says they are hardly subject to any deformity, that he never saw a hunch-backed Indian, and that it is extremely rare to see any who squint, or who are lame in the arm or leg. He repeats the same testimony very strongly concerning various tribes in South America; as, the Chaymas, Caribs, the Muyscas, and Peruvian Indians.

In no one instance do children resemble their parents so much as in the formation and arrangement of the teeth. But it often happens that the teeth of the parents differ materially from each other in size and formation; and when this is the case, a division often takes place in the family, and one child will present teeth similar to the father's, and

another similar to the mother's; and, in other cases, the child presents a mixture, a form and arrangement of teeth bearing a resemblance to those of each parent. This mixture often produces great irregularity in the arrangement of the teeth. For example, suppose the father to have teeth of the largest size, (and we know that the teeth differ very much in their dimensions,) and that they are placed in jaw bones sufficiently expansive to admit of their being arranged in regular order; and suppose the mother to have contracted jaws; it will often happen in such cases that the offspring will have jaw bones resembling those of the mother, and teeth placed in them resembling those of the father. In consequence of this disproportion, the teeth will not have room to arrange themselves in regular order, and they will be forced into clusters, the one before the other, thus producing receptacles for the retention of extraneous matter which occasions their destruction.

The defective secretion of enamel which occasionally takes place on the incisores and anterior molar teeth of the permanent set, I have been able almost invariably to trace to a deranged state of the health during the first few months after birth; it being at this early age that the formation of the enamel of these teeth commences. I may also advert to the extreme rareness of irregularity in the secretion of the enamel of the temporary teeth, which are formed in the jaws before birth: The fœtus being much less liable to derangement in its health than the recently

born. infant, the first set of the teeth will be the more likely to be perfectly developed than those which are to succeed them.

I feel persuaded that a perfect deposit, and a regular distribution of the enamel, very much depends upon a healthy and robust state of the constitution during the period when that substance is being formed. In some cases the secretion of the enamel appears to have been defective at the commencement, and to have been succeeded by a healthy deposit; in other instances the secretion may have begun properly, but before the crown of the tooth has been completely covered, derangement in the state of the health generally has perhaps disturbed the action of the membrane, and an imperfect secretion will have been the consequence. (Plate IV., fig. 4, *e, e*.) These alterations may, and no doubt do, occur in some constitutions, before the enamel is complete; and this appears to me to be the only probable way of accounting for this defect in its formation.

In the same way I would also account for that denuded condition of the teeth, occasionally met with, in which a portion of the enamel is gradually dissolved and removed, as if a round file had been applied across the anterior surfaces of the teeth, and the depressions afterwards highly polished. This loss of substance is produced, in some instances, I doubt not, by the too frequent application of the brush across the front surfaces of the teeth, instead of applying it upwards and downwards; but I have

frequently met with instances of this loss of enamel where it could not be attributed to the friction of the tooth brush. In this case the secretion of the enamel was not originally deficient in quantity, but this substance appears to have been, in these situations, of a softer nature than on the other portions of the teeth.

CHAPTER IX.

THE BONE OF THE TEETH; ITS INORGANIC NATURE.

IN concluding this portion of the work, and before proceeding to the practical part, I shall lay before the reader a few observations relative to the inorganic nature of the bone of the teeth.

That the enamel of the teeth is truly inorganic is now so generally admitted, that I may leave that part entirely out of view; and I shall, therefore, in the following remarks, confine myself to the consideration merely of the bony structure. Mr. Fox's theory of caries has been noticed in this treatise; the substance of it may be stated in the following words.—From some cause, but what that cause may be is not very clearly made out by Mr. Fox, inflammation is excited in the vascular membrane lining the cavity of a tooth, and in consequence of such inflammation the membrane separates from the bone with which it was in contact; a death of some part of the tooth speedily follows, and caries or decay is the result; the caries beginning, according to this writer, in the interior, and making its way to the exterior surface of the tooth. As I have already, I believe, sufficiently pointed out the erroneous nature of this view of the subject, I shall here only observe that

Mr. Fox supposes inflammation of the internal membrane to precede caries, whereas I have proved that caries always precedes and actually produces inflammation in the membrane, by exposing it to the direct and irritating action of food and other extraneous matter. Moreover, if the theory which Mr. Fox has advanced were correct, the operation of filling and filing the teeth for the purpose of arresting decay would be perfectly useless; this treatment, however, is well known to be effectual, by permanently putting a stop to the further progress of decay.

The theory of Mr. Bell, like that of Mr. Fox, rests on inflammation; but here the inflammation is no longer supposed to be in the internal membrane, but in the bone of the tooth itself; the author adding, that as the external surface of this bone, or that portion of it immediately beneath the enamel, possesses vital powers of the lowest grade, on account of its density, and its being the part most remote from the source of the vessels and nerves of the tooth, it will be the least able to resist the effects of inflammation, and gangrene of this part will be the consequence. I agree with Mr. Bell that its vital powers are of a very low grade, so low indeed, that it possesses none of the vital properties which characterise other bones. "The loss of substance occasioned by the friction of mastication is not repaired; a part broken off is never renewed, but the fractured surface remains unchanged; and a hole occasioned by decay is never again filled up. None, in short, of those pro-

cesses of restitution, which so strikingly characterise all organized bodies, for which alone powers of life and growth can ever be required, take place in the present instance ; so that if the bone of the teeth possesses vessels, they exist to no purpose, and manifest their presence by none of the usual phenomena."

"Such is precisely the reasoning employed to show that the enamel is not vascular ; and every argument tending to prove that position, will apply with equal force to show the want of vascularity in the bone of the tooth. If it be broken off it is never regenerated ; if it be filed away it is never reproduced. The same facts hold good of the bone of the tooth, and should lead us to the same conclusion. There is another effect of injury on the teeth, equally conclusive with the former, as to the non-existence of vessels in their substance. A violent blow will cause a general discoloration of a tooth, as if from a general effusion of blood throughout its texture. This effect never goes off. There are two ways of accounting for the appearance :—first, by supposing vessels to exist throughout the substance of the tooth, which pour out the blood in consequence of the injury ; or, secondly, by supposing that the vessel in the fang is ruptured, and that the effused blood mechanically discolours the substance of the tooth. If we adopt the former explanation, the colour ought not to be permanent ; for, wherever there are arteries, there must also be absorbents ; and these absorbents ought

to remove the effused blood as they do in bruises of the soft parts. By the latter explanation, we gain a satisfactory solution of the difficulty; we account for the duration of the colour in the same manner as of that which arises from feeding an animal with madder. The teeth are exempted from all those diseases which ravage the other bony structures of the body. *Lues venerea*, scrofula, and rickets, which attack all other bones, never produce the slightest effect on these organs, which remain unaltered, even in cases of *mollities ossium*, where all the other earthy matter of the system is absorbed. In short, the teeth never become constitutionally diseased; nor do they appear, in any instance, to participate in the least in general affections of the frame. A consideration of the mode of formation of the teeth will lead us to the same conclusion as the arguments already adduced so clearly and irrefragably establish. In this view of the subject, we must inevitably be struck with the great difference between the growth of the teeth and that of all other bones;—a circumstance which would naturally lead us to expect the differences which are found in their structure and economy. In the cartilaginous epiphysis of a young bone, vessels are seen entering from all sides. In the centre there is a small bit of bone of a loose and spongy texture, which can be made quite red by injection. We can trace this hardening, through every intermediate stage to that of perfect bone, the vessels of which, even in its most compact state, are still easily demonstrable

by the anatomist. Let us compare this with the growth of a tooth. If we examine it at ever so early a period, when a speck of ossification only can be discerned, the part which is then formed is complete, and has all the properties which belong to the bone of the perfect tooth. It does not undergo that gradual process of development which is seen in the growth of bones; but the smallest point, when once formed never alters. The arguments advanced by persons who hold a contrary opinion, who consider the bone of the teeth to possess vessels and nerves, and to be endowed with vitality, are so weak and indirect, in comparison with those which are to be urged against these positions, that we should, perhaps, stand excused, if we entirely omitted to notice them.”*

These are the remarks of a writer whose opinions on any part of human physiology are deserving of the highest consideration; I mean Mr. Lawrence, whose language I have preferred employing, as conveying in few words* what would only be weakened by any alteration of my own.

If Mr. Bell's theory were correct, the gangrene or decay ought always to commence at that part of the surface of the bone which is actually the most remote from the vascular membrane of the tooth; whereas decay is first observed at those parts of the surface of the bone which are really nearest to the membrane, such parts corresponding in a great degree to the deep pits and depressions on the exterior of the tooth.

* Article “Cranium,” Rees' Cyclopædia.

Again, all the teeth have a similar general formation; in all of them there is a bony wall surrounding an internal cavity, and a layer of enamel of variable thickness exterior to the bone; now if the theory of this author were tenable, all the teeth having thus a similar structure ought to have a similar and equal predisposition to caries; every one, however, conversant with dental surgery, and of course Mr. Bell himself, knows and admits that this is not the fact; all parties particularly noticing that special liability to caries in certain classes of the teeth, which, I venture to assert, is to be accounted for only by the explanation that I have given.

There is another circumstance which bears strongly on this point, namely, the greater liability of the teeth to caries in youth than in the later periods of life. In youth the surface of the bone, immediately within the enamel, is much nearer to the internal membrane than in the more advanced stages of life; (Plate IV., fig. 9, 10, *c, c*;) for, as this membrane continues to deposit layers of bone until the cavity is nearly filled up, the surface of this substance must of necessity be further removed from the centre of circulation, and consequently the predisposition to gangrene ought to be greater in the advanced periods of life than during its more youthful stages; but that this is not the case is a well authenticated fact.

Gold and platina are introduced not only into the enamel of the human tooth, but into this supposed vascular and sensible bony structure. Now, from our

knowledge of the laws of the animal economy, we know that the presence of a foreign substance in other parts of the body will certainly be attended by inflammation of such parts; but does this occur in the bone of a tooth? The gold or platina introduced, into the cavity of the bone which caries has produced not only excites no inflammation there, but actually arrests, when properly done, the very process of decay itself, and has been known to remain in such situation thirty years, without producing by its presence the slightest irritation.

Mr. Hunter fed young pigs with madder several weeks in succession, and then killed them; when he found that although all the other bones of the body were stained with the dye, this was not the case with the teeth to the same extent; for here it was evident that only those parts of the bone of the teeth which had been formed while the animals were undergoing the experiment, had received any tinge from the madder; and that the older portions of the bone retained their natural and usual colour. The same author also states, that when the teeth have once been thus stained they never regain their former appearance; though it is a matter of fact, that a colour thus given to other bones will be lost when the food of the animal is no longer mixed with the colouring matter;—a strong argument that the bone of the teeth possesses at least no absorbent vessels: But it is well known that absorbents are invariably found in all the vascular textures of the

body. "Is it at all probable that a vascular and sensible part should be destined to perform the trituration of the different hard bodies which constitute our food, and be exposed to the mechanical attrition which this office must necessarily occasion? Of what use could vessels and nerves be in a part like the tooth, which undergoes no natural change except the mechanical one of abrasion of surface, which is subject to no disease except one, that is referable to chemical action; which sets up no process of regeneration to repair the effects of either of these changes, or the consequences of accidental injury, and which, in every known state, is totally destitute in itself of all sensation? We desire to know what end could be answered by making these parts vascular and sensible."*

* Article "Cranium," Rees' Cyclopædia.

PART THE SECOND.

A PRACTICAL TREATISE
ON
THE HUMAN TEETH.

CHAPTER I.

RULES FOR THE MANAGEMENT OF THE TEMPORARY TEETH, AND FOR REGULATING THE PERMANENT ONES.

HAVING thus shown the incompetency of the theories hitherto advanced to explain the facts upon which they profess to be founded, and also their inconsistency with themselves, and having established, by proofs which I believe are incontrovertible, that, contrary to the opinions insisted upon in these theories, caries commences on the external surfaces of the teeth, and is occasioned by external agency; I now proceed to point out the practical and important application to which this view of the disease necessarily leads, by showing the possibility of preventing its commencement, or of arresting its pro-

gress before it has effected any serious and irremediable mischief. But I shall first make a few observations regarding the mode of treatment necessary for the preservation of the temporary set of teeth; and also the attention which is required at the period when the permanent set begin to make their appearance, in order to insure the regularity of those teeth that are intended to last through life.

The temporary teeth, although not so liable to caries as the permanent set, are nevertheless the subjects of decay, particularly the molar teeth. The disease generally commences in the interstices of these teeth, and is commonly attended with inflammation of the periosteum and of the gums; when this is the case, relief can be obtained only by removing the carious tooth. It is of great importance to preserve those teeth in a healthy state, and to prevent the necessity of their being extracted before the bicuspidæ, which supply their place, are ready to make their appearance; for, should it become necessary to remove them early, the permanent molar teeth, which take their stations immediately behind the temporary set, incline towards the front of the mouth, and encroach on the space allotted for the front permanent teeth.

The only means of prevention that I shall here recommend, is the daily application of the tooth brush, with water only, in order to keep the teeth as clean as possible. This simple treatment will be found, to a considerable extent, a preventive of decay, and

consequently, of much pain and suffering in the temporary teeth; and, moreover, will be of great service by initiating the child into habits of cleanliness, which will afterwards be of the highest importance for the preservation of the permanent teeth. The period at which the temporary teeth become more particularly an object of attention, is at the age of from five to seven years, when they are to be succeeded by a permanent set, more numerous, proportioned to the increased expansion of the jaws, of a larger size, firmer texture, and better adapted for the purpose of mastication.

About the age of three years, when the temporary set of teeth are completed, the form of the jaw is that of a semi-circle, and it is filled up to its whole extent with these teeth, twenty in number, ten in each jaw, namely,—

Two central incisores or cutting teeth,
Two lateral incisores or cutting teeth,
Two cuspidati or canine teeth,
Four molares or grinding teeth.

This part of the maxillary arch increases afterwards very little, if at all. In the course of between two and three years from this time, that is to say, a few months previous to the shedding of the temporary teeth, the two extremities of the jaw have elongated posteriorly to allow room for the first molar teeth of the permanent set. These teeth, from the inattention which is so general in the treatment of the temporary teeth,

are liable to be affected with caries at an early period; and when it becomes necessary to remove them, in consequence of acute pain produced by decay, the parents are often astonished when they are informed that these teeth belong to the permanent, and not to the temporary set.

The jaw continues to elongate in the same direction, so as to admit successively of the second molar teeth and the *dentes sapientiæ*, thus completing the permanent set; and at this period, the jaw, which at the completion of the temporary set, presented the form of a semi-circle, approaches to that of part of an ellipsis, or, in other words, resembles a horse shoe in shape. According to this arrangement of nature, it will be seen that the room occupied by the twenty temporary teeth is filled with the same number of permanent teeth; but as the teeth of the two successive sets are not respectively equal to one another in size, it will here be necessary to explain how they come to be arranged in the same space. This is of the more importance, as the irregular position of the teeth is one of the principal predisposing causes of caries.

The incisores and cuspidati of the permanent set are considerably larger than the corresponding teeth of the temporary set; whereas the molar teeth of the temporary set are much larger than the bicuspidates of the permanent set which succeed them. And here it is obvious, that the additional room required for the permanent incisores and cuspidati is com-

pensated by the smaller space occupied by the bicuspidæ.

The formation of the maxillary arch in different individuals is exceedingly various. When we find the jaw sufficiently expanded, and the temporary teeth a little separated from each other, the arrangement of the permanent set may be safely left to nature; but when the jaw is contracted, and the temporary teeth arranged closely together, it becomes necessary, in order to insure the regularity of the permanent teeth, that nature should be assisted; and with judicious management, there are but few cases which are not under the control of the operator, by the removal, from time to time, of the temporary teeth, to make room for those of the permanent set which succeed them.

The shedding of the teeth commences with the central incisores of the lower jaw; sometimes the fangs of these teeth are absorbed, and their crowns fall out spontaneously, that is, when the permanent teeth come up immediately under them. But even when this is the case, the space previously occupied by these teeth may be too narrow to admit of the permanent teeth; and if so, they are forced out of the circle by the contiguous temporary teeth, and stand either obliquely or the one before the other. In order to remedy this defect, it becomes necessary to remove the lateral temporary incisores; and for the same reason, when the lateral permanent incisores make their appearance, the temporary cuspidati must be removed to make room for them. When these

six temporary teeth have been removed, we generally find the greater part of the space which they occupied filled up by the four permanent incisores.

When the permanent incisores of the lower jaw appear behind those of the temporary ones, absorption does not take place in the fangs of the temporary teeth, and consequently they remain firm in their sockets; nevertheless they ought to be removed, in order to admit of the permanent teeth coming forwards into place.

Similar treatment to that above described will be necessary for the regulation of the teeth in the upper jaw. When the temporary incisores and cuspidati have been removed, a considerable period may be allowed to elapse before any further assistance is requisite. In twelve or eighteen months from this time, the fangs of the temporary molar teeth become absorbed, the bicuspidates generally coming up immediately under them, and their crowns drop out of their own accord, or become so loose as to be easily removed; but should the bicuspidates take an irregular direction, either inside or outside of the circle, the temporary tooth must be removed to allow the permanent one to take its place.

The cuspidati seldom appear before all the temporary teeth have been shed, and the bicuspidates and incisores have been arranged in their respective situations; and these teeth, the bicuspidates and incisores, sixteen in number, frequently fill up the whole of the space previously occupied by the twenty temporary

teeth so as to prevent the cuspidati, particularly those of the upper jaw, from falling into the circle. In this case, the cuspidati occasion great deformity by projecting beyond the range of the other teeth. Unskilful practitioners frequently remove these teeth in order to remedy the deformity, thereby destroying the symmetry of the mouth, and sacrificing a class of teeth which, from their strength and durability, are of the greatest importance in after life; whereas the removal of the anterior bicuspidæ, which are teeth of much less consequence, because more liable to decay, and the abstraction of which does not interfere with the symmetry of the mouth, would effect every purpose by allowing the cuspidati to fall into their proper places in the arch of the jaw. The remaining teeth which have yet to appear are the second molares and the *dentes sapientiæ*, which take their places in due course, and complete the permanent set.

Before dismissing this part of the subject, I shall point out some of the bad effects which result from inattention to the teeth during that period which is termed the shedding of the teeth. We have before stated, that when the teeth are irregular in their arrangement they are more subject to caries, inasmuch as there are situations produced by this irregularity calculated to retain particles of food, which in a well-arranged set of teeth would not be the case; and, moreover, that it is scarcely possible to prevent an accumulation of a substance called "tartar" from

taking place on those teeth which stand out of the range, as they escape the friction of the brush during the process of cleaning. The irregularity of the teeth, in many instances, also occasions very considerable deformity in the appearance of the face; this is more particularly the case when the upper front teeth, instead of closing over the lower ones, shut within them, and consequently give an unnatural projection to the lower part of the face. When one or more of the teeth take this position, it becomes necessary to have recourse to artificial aid, otherwise the defect will be permanent. In order to rectify this deformity, a plate is adapted to the lower range of teeth, and so constructed as to produce pressure upon the irregular ones; (see Plate v., fig. 1, 2;) by which contrivance the rest of the teeth are prevented from coming in contact with each other, and the whole pressure of the mouth in shutting is thrown upon the irregular teeth, which act against the inclined surface of the plate, and by degrees are moved forwards into their proper situations. (Plate V., fig. 1, 2.)

CHAPTER II.

THE MEANS WHICH ARE TO BE EMPLOYED FOR PREVENTING DECAY IN THE PERMANENT TEETH. FILLING TO BE HAD RECOURSE TO FOR THE PURPOSE OF PERMANENTLY ARRESTING CARIES OF THE TEETH.

HAVING laid down rules for the management of the temporary teeth, and for regulating the permanent ones, I proceed now to consider the further treatment of the permanent teeth, as regards the prevention of decay, and the mode of arresting it where it has already commenced; and here I would impress the reader with what, I flatter myself, constitutes the great value of the suggestions contained in this treatise, and which are, I trust, sufficient to prove that the most watchful attention should be paid to those teeth from their first appearance; for such is their susceptibility to decay in youth, that caries produces its greatest ravages before the age of fifteen or twenty years; and such is the insidious nature of caries, that it effects irreparable mischief, often before it has been suspected to exist.

The greater liability of the teeth to decay in the earlier than in the more advanced periods of life, was

formerly alluded to when I noticed it as a fact brought forward, but not explained, by Mr. Hunter; and showed that it admitted readily of explanation by the theory which I have advanced, namely, that disease in the teeth is caused by external agency; that is, by the decomposition and chemical action of particles of food retained in the cavities and interstices of the teeth.

The greater frequency of caries in youth has been shown to arise from the irregularities of the surfaces of the grinding teeth being deeper, and therefore more liable to retain food at their first appearance, and in the youthful stages of life, than at a more remote period.

It must always be remembered, that the enamel when once formed undergoes no change, with the exception of the flattening of the grinding surfaces of the teeth, which is occasioned by friction during the process of mastication. If, upon the first appearance of the teeth, they present pits and fissures capable of retaining extraneous matter, in these situations decay will immediately commence, and in a few years these teeth will be destroyed.

In the early periods of life, too, the progress of decay is more rapid in effecting their destruction, because the internal cavity of the tooth being larger, and the wall of bone between the cavity and enamel being consequently thinner, decay has a shorter distance to penetrate before it exposes the internal membrane; whereas, in the middle and later stages of life, the bony partition becomes con-

siderably thickened, so as to increase the distance between the surface of the tooth and the cavity. See Plate IV., fig. 6, which represents a young tooth, as compared with fig. 7, of the same plate, which is an old tooth.

It also too often happens, and is another cause of the frequency of caries during the period of youth, that, at this time, when the greatest liability to the disease exists, the precautionary measures for preserving the teeth are the most neglected; and it is only after acute suffering and irremediable mischief have been produced, by the loss of several teeth, that means are adopted for preserving those which remain.

The first, and one of the most important precautionary measures to be adopted, is that of cleanliness; and I have been the more particular, on a former occasion, in insisting upon the early use of the tooth brush, not only as the means best calculated for the prevention of decay in the temporary teeth, but in order to establish and confirm those habits of attention so necessary for the preservation of the permanent teeth.

In order to preserve the teeth from caries, it is absolutely necessary that they should be brushed once in twenty-four hours, and so effectually as to remove any portion of food which may have adhered to them.

This will prevent the remains of food from undergoing decomposition in the situations already described, the putrid matter arising from which has been pointed out as the active agent of destruction; it is better,

however, to clean them morning and night; but the strict rules of cleanliness require the use of the brush at the termination of every meal.

The ablution of the teeth, in many instances, is performed in that superficial manner which does little or nothing for the prevention of decay. The operation of the brush is generally confined to the front teeth; and whether confined to these or extended over a larger range, it is almost always applied across their anterior surfaces only; and the irregularities upon the masticating surfaces of the double teeth, and the interstices in which the food is the most liable to lodge, and consequently the most subject to decay, are altogether neglected.

The most effectual method for removing the particles of food from the interstices of the teeth is to brush them upwards and downwards, and the brush should be firmly applied across the masticating surfaces of the double teeth; and if it were possible by these means to keep the teeth perfectly clean, and to dislodge all the food which is retained in their indentations and interstices before decomposition could take place, it is not improbable that caries would be as seldom met with in the teeth as in other bones, in which indeed it sometimes takes place, but is a circumstance of rare occurrence. But it must be allowed, that in a vast number of cases, from the deeply indented and irregular structure of the teeth, it is not practicable, by the most rigid attention to the rules of cleanliness, to prevent the decom-

position of food in some of the situations already noticed; (Plate IV., fig. 9, *b*;) the consequence of which is, that decay must and does ensue; and here it is obvious that another mode of treatment becomes necessary in order to arrest the further progress of the disease.

I scarcely need remark that the only treatment which can be adopted under these circumstances, for the preservation of the teeth, and the only one which has ever been found effectual, consists in filing away the carious part, or in eradicating the spongy and decayed portion, and subsequently filling the cavity which the disease has produced. But such, unfortunately, is the insidious character of caries, that we cannot sufficiently impress on the mind of the reader the necessity of a careful and continual watchfulness over these organs so important to health and comfort, for the purpose of detecting decay in its first stages, before it has proceeded so far as to produce pain or even tenderness.

This attention to the teeth should commence at the early age of six or seven years, when the first molar teeth of the permanent set have pierced the gums. As these teeth are very subject to decay soon after they have made their appearance, it becomes the duty of parents to have the teeth of their children regularly inspected, and this examination should take place at least once in every twelve months; and to insure their safety, it should be continued yearly throughout the future periods of life. If this system

were more generally adopted, the necessity of extracting teeth, which is so common, would be of less frequent occurrence, and consequently much pain and inconvenience would be prevented.

An experienced practitioner will have no difficulty in discovering the first stages of caries; nay, from the first appearance of the teeth through the gums, he will be able to foresee, from their construction, which of them, and what parts, are predisposed to decay. The only situations where caries may commence and proceed without detection till it becomes incurable, are the interstices of the double teeth; (Plate II., fig. 6;) and even in those situations, in a vast majority of cases, decay may be detected before much mischief has been produced.

The object and advantages of constant watchfulness and regular inspection of the teeth as now suggested, are to arrest the progress of decay before it has penetrated to the internal cavity of the tooth, and exposed its vascular membrane to the influence of foreign bodies; this is accomplished by filing away the carious part, or by eradicating the spongy and decayed portion, and subsequently filling the cavity which the disease has occasioned. For the successful practice, however, of either of these processes, it is evident that we ought to have a clear idea of the object of them.

The cause of caries being, as we have minutely pointed out, the corrosive action of decayed particles of food, it must be obvious that the method that we

propose for preventing the further progress of decay, must consist in remedying the peculiarity of structure which led to it. If, for example, decay takes place in one of the deepest indentations of the masticating surface of a grinding tooth, in order to arrest its progress, the decayed part is removed and the cavity stopped up; consequently a future lodgment of food is prevented.

When we have recourse to the process of filing, the object and principle are the same as in filling; for instance, when decay takes place on the side of an upper incisor, the carious part, owing to the thinness of the edge of the tooth, or the shallowness of the decay, its position or formation, may not admit of filling; and in such cases filing is had recourse to, for the purpose of removing the carious portion and effecting a separation from the adjoining tooth, thereby making the part plain and smooth, and doing away with the necks and points of union which, by retaining the food, had laid the foundation of decay. It is, of course, to be understood that these operations have been performed in the earlier stages of decay, and before it has penetrated to the internal cavity of the tooth, when preventive measures are no longer available.

I shall now point out that stage of caries which is the most favourable for performing the operation of filling, and show the practical advantages derived from timely attention, and the bad effects which result from neglect.

In order to make myself clearly understood, I shall take, as an example, one of the molar teeth. These teeth, as before stated, are more subject to decay than any others, on account of the irregular formation of the enamel upon their grinding surfaces; and this formation is exceedingly various in different individuals; but in all cases, the surfaces of these teeth are irregular, and indented to a greater or less degree. This tooth generally presents three or four prominences around its grinding surface, with a deep depression or pit in the centre. Such formation is peculiarly adapted for the retention of food; and so deep are the pits in many instances, that it is hardly practicable, even with the most rigid attention to the use of the brush, to dislodge the particles of food. The rapidity of the corrosive action upon the tooth will depend upon the form and depth of the indentation, and in some degree upon the quality of the food; but the effects of this chemical agent may in some degree be retarded, even in the worst cases, by the firm application of the brush accross the masticating surfaces of the teeth, which removes at least a portion of the destructive substance, and lessens the power of its operation.

The earliest effects of the disease become apparent by a discoloration of the deepest part of the indentation, and this may be considered the first stage of caries; but, as the action proceeds, the part at first merely discoloured becomes black and corroded, and during this second stage, the disease works its way

through the bottom of the indentation in the enamel, and commences its ravages on the surface of the softer bone within; and upon examining the tooth at this period, we shall find an easy passage for the point of a probe through the black and corroded portion of the enamel. When decay has proceeded thus far, no time should be lost in having the operation of filling performed; for, after the disease has penetrated through the enamel to the softer bone, its progress upon this substance becomes much more rapid.

At this stage of the disease, not even the slightest tenderness has been produced, for the internal cavity of the tooth containing its blood vessels and nerves, continues protected by a partition of healthy bone, upon whose surface, as yet, the putrid action has only commenced; this is, therefore, the most favourable period for performing the operation of filling, previously to which every particle of carious and corroded substance must be removed with small instruments adapted to that purpose. The cavity should be wiped perfectly dry, and then filled up firmly and securely with gold leaf, or with a substance not liable to undergo a chemical change. When this operation has been performed with skill, the decay is arrested in its career, the lodgment of food which was the original cause of the mischief, is for the future prevented, and the tooth is permanently saved.

But here it may be necessary to remark, that the configuration of some of the teeth, particularly the

molar teeth, is of a nature which predisposes them to become carious in more parts than one; for instance, instead of the more usual construction of a molar tooth, consisting of three or four prominences around its grinding surface, and one pit in the centre, (Plate II., 1, 2, *a, f, h,*) it often happens that a ridge extends across the surface, thereby producing two pits; (Plate II., fig. 1, 2, *b, c, g*;) and in many instances also a fissure extends across the margin of the grinding surface, and forms a cavity in the side of the tooth. (Plate II., fig. 1, 7, *d, e, g, r.*) All these circumstances occasion caries, because they all more or less cause the retention of food; and we shall find the situation which is the most calculated for retaining it, the first to require the operation of filling. I have often found it necessary to perform this operation in three distinct parts of the same tooth at different periods.

I have been led to the particular notice and explanation of this fact, from the circumstance of Mr. Bell having brought it forward as a confirmation of his theory of predisposing causes, inflammatory action, &c., as has been stated in a former part of this treatise. Mr. Bell says, "The removal of one, and that the immediate and exciting cause of the progress of the disease, will indeed be effected;" that is by filling up the cavity; "but the predisposition will still exist in the apparently sound part of the tooth, and will be likely, at a future period, to give rise to the renewed appearance of decay. Hence it some-

times occurs, even when the gangrened part has been most completely removed, and the stopping effected in the best possible manner, that the disease will subsequently appear in another part of the tooth, while the stopping remains perfect and untouched. Without a proper understanding of the cause of gangrene, it would be impossible to explain this circumstance.”*

It will be evident to the reader that the predisposition to caries in several parts of the same tooth, is not, as Mr. Bell supposes, a predisposition to inflammation from some original or acquired unhealthy condition of the tooth, but that it is occasioned by the crevices and indentations of the teeth, in which food is liable to lodge, and in which decay is exclusively found.

We have stated that when once the decay has made its way through the enamel to the softer bone, its progress becomes much more rapid, the substance now acted upon being of a soft nature compared with the dense and firm structure of the enamel. The corrosive action, during the third stage, is principally confined to the softer substance, and the orifice in the enamel increases comparatively but little, whereas the chemical action proceeds with accelerated power in excavating that part of the bone immediately within the enamel; but even at this stage decay may be permanently arrested in its progress, and the tooth saved by the same process as that recommended

* Bell, page 142.

during the second stage, with this difference, that it now becomes necessary to enlarge the orifice in the enamel for the purpose of accomplishing the removal of the carious substance within ; and, when this has been effected, the cavity will be found much larger internally than at the external opening. It will be evident that this operation must be useless, unless a portion of healthy bone remain to protect the internal cavity of the tooth.

The beneficial result of the operation of filling depends in all cases upon the previously complete eradication of every particle of the carious structure ; for, should the filling be introduced over a portion of the decayed and spongy substance, the process of corrosion will go on, the morbid excavation increase, the filling become loose, and the operation prove altogether nugatory. This constantly occurs when the operation is performed by unskilful persons, who, from their ignorance of the nature and progress of the disease, and, from their not being aware that the sound parts of the tooth are contaminated by the corrosive action of the unsound, are quite indifferent about removing the decayed portion.

In the opinion of the inexperienced practitioner, the utility of filling is limited to the exclusion of air from the interior of the tooth ; and their patients are beguiled into a temporary, false security, that this being done, however superficially, every possible advantage has been obtained ; nor are such practitioners scrupulous by what means this is accomplished, fre-

quently cramming into the decayed cavity of a tooth substances, under the boasted name of specifics, which are liable to excite corrosion, and which consequently tend rather to increase than to retard the progress of the disease.

The next stage of caries is the period when application is generally made for assistance, but unfortunately it is also the period when remedial measures are no longer available; for at this stage decay has made its way through the bony partition, thereby exposing the internal cavity of the tooth, and producing inflammation in its lining membrane, which is the origin of the pain and suffering called tooth-ache. To attempt the operation of filling at this period would be in the highest degree irrational; it is impracticable, indeed, from the torture which it occasions, and the only relief that can be obtained under these circumstances is by the removal of the tooth. This is the treatment that I should recommend in a great majority of cases, for reasons which shall be explained after I have made a few observations on the operation of filing the teeth, which is had recourse to in cases where filling is impracticable.

CHAPTER III.

FILING THE TEETH. THE ADVANTAGES WHICH
RESULT FROM THIS OPERATION.

I HAVE before stated that the object and principle of both these operations are the same; I have shown that by timely attention to filling, before decay has reached the internal cavity, and excited inflammation in its lining membrane, the disease may be arrested in its progress, and the tooth permanently saved by effectually removing the carious portion, and subsequently stopping up the orifice firmly and securely. But when decay commences on the side of a tooth, in a situation where it is impossible, from the obstruction occasioned by the adjoining tooth, to make use of the excavating and filling instruments, or when the tooth is incapable of retaining the stopping, in consequence of the formation of the fissure which the decay has produced; or if the side of the tooth be very thin, or the cavity shallow, in all such cases it is necessary to use the file till every portion of the carious substance is removed, and the cavity completely obliterated: no food being then retained, the recurrence of the evil is prevented.

The passing of a file between two teeth, merely for the purpose of making a separation, when decay

has penetrated through the enamel, and produced a cavity in the side of one or both of the teeth, will not be sufficient to prevent the further progress of decay: it will in some degree retard it, but the corrosive action will still go on unless the cavity be wholly obliterated, and the deposition of food prevented for the future.

When we have recourse to filing, a portion of the sound part must be removed with the unsound; for, were the carious portion only to be got rid of, the remaining cavity would allow of subsequent collections of food, which must unavoidably renew the decay; but by removing the neighbouring parts to a level with the bottom of the morbid cavity, and thereby giving the whole a plain surface, the liability to decay is done away with. In performing this operation, the substance of the front surface of the tooth, should, as far as possible, be saved, so as to preserve its natural shape and appearance, which, in most instances, may be done by using the file in a slanting direction.

A strong prejudice exists in some individuals against the filing of the teeth, which is grounded on a mistaken idea that the removal of a portion of the enamel must necessarily lead to their destruction. Experience has long since proved the fallacy of this notion; for, if the decay has not penetrated to the internal cavity, and a portion of healthy bone be still left to protect the membrane, the carious part may be removed with the file, and the tooth will continue free from decay.

The Abyssinian negroes, and several of the Indian tribes, are in the habit of filing off the cutting edges of the front teeth, both in the upper and lower jaw, in order to give them a pointed form ; and this operation they are careful not to carry too far, so as to expose the internal cavity of the tooth. It is a well ascertained fact, that the teeth of these savages thus filed, are not subject to decay. I am far from recommending the practice of filing the teeth, except in cases of necessity ; and I have merely stated this fact to show that the judicious filing of the teeth does not subject them to decay. I have seen many instances of teeth which had undergone the process of filing, and to a very considerable extent, some thirty years ago ; and I have found the operation to be successful in arresting the progress of decay ; for, after this lapse of time, the filed teeth have appeared the same as at the period when the operation was performed.

The bone within the enamel is of the same substance and density as the fangs ; and it is a very common occurrence for a portion of the fang of a tooth to become exposed in consequence of the receding of the gums. The fang, being thus deprived of its natural covering, is equally liable to external injury with that portion of the tooth which has been deprived of its enamel by the file ; yet we do not find the fang thus exposed subject to decay if it present a plain surface, which it generally does. I have no doubt, therefore, that the prejudice which has been alluded to may be traced to the unskilful performance

of the operation, and to ignorance of the nature and progress of the disease.

During the first stage of caries, when the surface of the enamel is only discoloured, the passing of a thin file between the teeth will remove the obstruction, and prevent a future lodgment; but if decay shall have advanced beyond its first stage, and produced a cavity in the side of the tooth, the simple operation of separating one tooth from the other will not be sufficient to arrest the progress of decay; for the orifice still remaining, will of itself be capable of retaining particles of food, and consequently, the corrosive action will still go on excavating and undermining the enamel, until a portion of it, having lost its support, suddenly breaks off;—a circumstance that would have occurred had no filing taken place. When this event happens soon after the process of filing, the patient is very likely to attribute it to that operation; but the reverse of this is the fact, for the operator, either not being aware of the true state of the disease, or being ignorant of the consequences of leaving an orifice in the side of the tooth, has contented himself with merely making a separation, and has failed in not carrying filing to a sufficient extent, so as completely to efface the cavity; the consequence of which is, that the exciting cause is left to pursue its natural course, and to produce the effects described.

When decay begins in the interstices of the teeth, in a situation where it becomes necessary to have recourse to filing, it is advisable to perform the opera-

tion in the earliest stage of decay ; for at this period the opaque or dark portion may be removed without penetrating through the whole thickness of the enamel ;—a convincing proof, by the way, that decay commences externally and not internally, as Mr. Fox supposes, nor upon the surface of the bone within the enamel, as Mr. Bell has imagined.

The advantages resulting from the early attention to filing, are, not merely that the decayed part is removed and the mischief arrested, but that these objects are effected without altering the natural shape of the teeth,—a change which it is very desirable to avoid, particularly with those in front.

But when decay begins upon the grinding surfaces of the double teeth, or any other situation where filling is practicable, it is quite unnecessary to perform the operation during the first stage of the disease : It is better to wait until it has effected a small opening through the enamel, capable of admitting the point of a fine probe. The removal of the whole of the carious portion, at this period, will be no more than sufficient to give the aperture that form which will adapt it for retaining the stopping ; and were the operation to be performed upon the first appearance of discoloration, no advantage would be gained, for an opening equal in size to that occasioned by the second stage of the disease would be required to be made.

Mistaken notions regarding the true nature of decay of the teeth, and its exciting cause, have led to

premature treatment, not only in filling the teeth, but also in the operation of passing a file between them, which has been recommended by Mr. Fox and others as a preventive to decay; a practice which, to say the least of it, is exceedingly injudicious, and which never ought to be had recourse to before decay has commenced.

Mr. Fox says: "The incisores of the upper jaw are very liable to become carious, in consequence of being crowded or pressed much against each other. To prevent this disease from taking place, it is advisable to make a separation between each tooth with a very fine file."* Mr. Fox has evidently been led into this error by the mistaken notion which he entertained of inflammation of the internal membrane of the tooth being the exciting cause of caries. Had he taken into consideration the composition, the thickness, and the unyielding nature of the walls which surround the membrane, he would have perceived that there was no danger of its sustaining injury in consequence of pressure from without. Had he been more minute in his observation, he would also have perceived that decay does not take place at the points where the teeth are in contact, but immediately above, where the points of union form a resting place for the food.

The treatment recommended by Mr. Bell, is similar to that of Mr. Fox. "When, from the want of room in the maxillary arch," says he, "the

* Fox, Part II., page 145.

teeth are so crowded as to press with considerable force against each other, this pressure should be removed by passing a very thin file between those which are in the greatest degree subject to it.”* If the pressure of the teeth against each other occasioned decay, as supposed by the authors just quoted, how does it happen that the lower incisors are not equally liable with the upper to the same disease? The lower front teeth, are generally more crowded than the upper ones, and the pressure must be equally great; consequently, if decay proceeded from this cause, the liability in the lower teeth would be as great as in the upper ones: but that this is not the case, is a fact acknowledged by both these gentlemen, and must be obvious to every one who has given any attention to the subject.

I have before stated that the liability of the teeth to caries in this situation, depends upon the formation of their interstices, and their liability to retain particles of food. The experience of every day proves that decay is not produced by the pressure of the teeth against each other, for we constantly meet with well formed and regularly arranged teeth, the sides of which press against each other without the least tendency to decay.

In taking a front view of the upper incisors, it will be observed that they are broad at their cutting edges, and in many instances diminish very suddenly

in width towards their fangs, thus producing an opening between the gum and the points of union at their sides; but this is not all. When a tooth tapers suddenly, there is generally a depression or neck immediately above where the union at the sides terminates, which forms a situation extremely liable to retain food, and consequently to produce decay; (Plate III., fig. 2, *b, b, b, c.*) On the other hand, when the width of these teeth is more uniform and regular, the union at their sides extending to a greater distance from the cutting edges, the gums, if in a healthy state, send out processes which fill up the interstices, and thus prevent a deposition of food from taking place. (Plate III., fig. 1.) With regard to the lower incisores, they are always more uniform in their shape than the upper ones, and do not present interstices of a similar kind to those we have described between the upper teeth, and on this account they are not so subject to decay.

The filing of the teeth produces an unpleasant sensation, sometimes a painful one; and this circumstance has been brought forward to prove that the bone of the tooth is an organized substance, and subject to inflammatory action; for, say the advocates of this doctrine, if the bone of the tooth be an inorganic substance, how is this painful sensation to be accounted for? This appears a very plausible objection, and one not unlikely to mislead those who have taken only a *primâ facie* view of the subject; but the sensation produced by filing the teeth may be

satisfactorily accounted for without supposing the bone of the tooth to be organized.

It is now admitted by every one who has paid any attention to the subject, that the enamel of the tooth is an inorganic substance; and I would ask, Is there no painful sensation produced by filing the enamel? Most assuredly there is. In filing the cutting edges of the incisores, when it becomes necessary to remove only a small portion of the enamel, and in dividing the one tooth from the other when only the surface of the enamel is taken away by the file, the sensation is often so painful that it is sometimes with difficulty that we can get the patient to submit to the completion of the operation; and yet there can be no feeling in the enamel.

Again: Is there no sensation, no pain, produced in filing the crown of an artificial tooth, which has been fixed by a pivot to the natural fang retained in the socket? Surely there can be no feeling in the artificial tooth; and yet, the application of the file to the crown of a tooth thus attached, produces a similar sensation to that which is occasioned by the filing of a tooth naturally connected with its socket. That portion of the tooth which is fixed by the pivot must be void of feeling; and so are the enamel and bone. The sensation, therefore, which is produced by the file, does not arise from these, but from the internal membrane and periosteum of the tooth. These membranes are disturbed and excited, partly from the heat produced by the friction of the

file, and partly from the tremulous action which is conveyed to them by the working of the file upon the external parts of the tooth. It is also natural to expect that this sensation will increase the longer the operation is continued, and the nearer the file approaches the periosteum or the internal membrane.

The nature of the sensation arising from filing will also depend upon the state of health of the membranes, particularly of the periosteum: if the latter be at all inflamed, the friction of the file upon the tooth cannot be endured. In the case of the pivoted tooth, the sensation arises entirely from the periosteum, the internal membrane being destroyed by the insertion of the pivot into the natural duct of the fang, the empty seat of the internal membrane. So sensitive are the nerves of some people, that they can scarcely endure a file to touch their teeth; nay, even the harsh sound which is produced by two hard substances grinding against each other will affect them; such, for instance, as the noise occasioned by the sharpening of a saw with a file. Others will endure the operation of filing the teeth, apparently, without much feeling.

For the successful performance of the operations of filling and filing the teeth, it is absolutely necessary that the dentist should have a correct knowledge of the nature and character of caries of the teeth. There is an old adage, that before attempting the cure of a disease, the better way is, first to

find out the cause of the complaint; and then proper means, most likely will be employed to remedy the evil. But it appears at first sight that this principle is not applicable to the management of the teeth; for it is a singular fact that however much dentists may differ in opinion, as to the cause and nature of caries of the teeth, all apparently agree in their mode of treatment; all have recourse to the same means for arresting the progress of decay in a tooth, and that is, either by filling or filing it. Nevertheless, it will appear obvious from the following remarks, that a correct knowledge of the character of caries of the teeth is necessary for the successful performance of either of these operations. In performing them, surely the dentist has some object in view. What is his object? He supposes for instance, (and this is no uncommon supposition,) that decay has been occasioned by the pressure of the one tooth against the other; he will, therefore, use the file for the purpose of effecting a separation, and relieving the pressure; and having done this, he will feel satisfied that the exciting cause has been removed. Another dentist takes a different view of the cause of caries of the teeth; he supposes decay to be the result of chemical action, and that this action is produced by a lodgment of decomposed particles of food between the teeth; he has also recourse to the file, but he is not satisfied with simply dividing the one tooth from the other; for, after the separation has been made, he carefully ex-

amines the sides of the teeth, and if he finds that decay has penetrated so as to have formed a cavity in the side of either the one tooth or the other, he again has recourse to the file, and continues the operation until he has removed the whole of the cavity, thereby making the side of the tooth plain and smooth; and then he feels satisfied that he has arrested the progress of decay, because no lodgment can take place in that situation for the future. In filling a tooth, he proceeds upon the same principle; he is particular in removing the whole of the decayed portion from the cavity; at the same time he gives it a form calculated to retain the filling; he is careful in wiping the cavity perfectly dry before the filling is introduced; and he is also particular as to the kind of substance he introduces into the tooth; he uses either gold or platina, neither of which metals is liable to corrode; and, by the firm application of his instruments, he condenses the filling so effectually and securely as to fill up the cavity in all its parts, to a level with the surface of the tooth; and by this means he prevents the possibility of a lodgment of decomposed matter in this situation for the future.

Another case comes under his notice: it is one where decay has made considerable progress, where it has penetrated through the enamel and bone of the tooth, and consequently the membrane has become exposed and inflamed. The patient is desirous of having the tooth filled up, in order that he may

be relieved from the pain of tooth-ache; and for this purpose he visits the dentist, who declines performing the operation because it has been too long delayed; he foresees the mischief which will result from filling under such circumstances; he is aware that the introduction of a foreign body into the cavity of the tooth, producing pressure upon the inflamed membrane, will only aggravate the evil; and he therefore recommends the patient to have the tooth removed, as the only means of obtaining relief. The dentist will then examine the remaining teeth, and if he finds that decay has commenced upon any of them, he will point it out to his patient, and explain to him the necessity of having them attended to before decay arrives at the same stage as in the tooth now lost. The patient will also be told, that in order to have the operation of filling performed successfully and beneficially, it must be done before the occurrence of pain, during that period when the decay is confined to the insensible part of the tooth, and while there is still a partition of sound bone left to protect the internal membrane. The dentist will see it to be his duty to put his patient upon a different plan of managing his teeth for the future; he will tell him that in order to preserve the teeth, they must be kept perfectly clean; and if this could be done by his own efforts there would be no necessity for the assistance of a dentist; but as this is not practicable, there being situations where extraneous matter will

lodge and occasion decay, the only method of preserving his teeth is to have them regularly inspected, at least once in twelve months, in order that decay may be detected and arrested before pain is produced.

If correct notions of the exciting cause of caries be not entertained, it is not to be expected that the operation of filling will be beneficially performed. It is the opinion of most people, but it is a very erroneous one, that the benefit which results from filling up the cavity in a carious tooth, is, that it keeps out the cold and the air from the nerve. With this mistaken notion and silly object in view, the dentist proceeds to the performance of the operation.—The necessity for removing the whole of the decayed portion, and cleaning out the decomposed matter previously to the stopping up of the cavity, never enters his mind;—the filling up of the cavity, and the exclusion of the cold from the nerve of the tooth, as he supposes, is all that is required: nor is it very likely, entertaining such a notion, that he would be particular as to the nature of the material which he would use for this purpose; at all events, whether the metal used be liable to corrosion or otherwise, it would be crammed into the hollow part of the tooth, over the decomposed matter which would remain at the bottom of the cavity, and the putrid substance being thus enclosed below the filling, the chemical action would go on more rapidly, perhaps, than if no operation had been performed.

CHAPTER IV.

STAGE OF CARIES WHEN IT BECOMES NECESSARY TO
EXTRACT THE TEETH.

I now return to that stage of caries in which preventive measures are no longer available, and when the only relief that can be obtained is by the removal of the decayed tooth. There are, however, many individuals who will not submit to the operation of extraction, under an impression that the pain will subside, and the tooth still remain useful. The erroneousness of this opinion, in the great majority of instances, will appear from the following statements:—

I have before observed that, when toothache takes place, caries has extended to the internal cavity of the tooth, and excited inflammation in its lining membrane; and it is upon this membrane, which is spread over, and is closely attached to the bony walls of the internal cavity, that the blood vessels and nerves, which enter the tooth by the points of the fangs, are distributed in an infinite number of small ramifications. In this respect the crown of the

tooth, or that part which is above the gum, differs essentially and completely from other bones, the latter being surrounded by an external membranous covering called the periosteum, which is protected from the action of extraneous bodies by the integuments and other textures; whereas that part of a tooth which is intended for mastication, and therefore exposed, is supplied with a membrane placed in the centre of the organ, which is protected from external injury by the bone and enamel surrounding it.

It is upon this difference of construction between the teeth and other bones, that depends the more acute pain incident to inflammation of the internal membrane of the former, than that which attends the inflammation of the investing membrane of the latter. One of the constant and necessary effects of inflammation, in every structure of the body, is a swelling of the part inflamed; and the consequence of this tumefaction, when the surrounding parts are soft and yielding, is a diminution of the pain, the degree of relief being in proportion to the softness of these parts, and their consequent facility of giving way to distension. Accordingly, when inflammation attacks the periosteum, or external membrane of a bone, the surrounding parts being soft, and of course readily yielded to the expansion of the inflamed blood vessels, the pain is comparatively slight. On the contrary, when inflammation is excited in the internal cavity of a decayed tooth, there is an insurmountable resistance to the expansion of the inflamed

vessels, which produces that most acute and excruciating pain, the toothache.

Occasionally the destruction of the teeth is effected without pain; for when the caries has laid open the membrane of the tooth, it becomes absorbed, not inflamed, and no pain is produced; but this is a circumstance of rare occurrence. When the cavity of the tooth is about to become exposed, pain usually begins and continues with intermitting paroxysms, till the internal membrane becomes wholly obliterated, and only terminates with its destruction. When this has been accomplished, the only living part connected with the tooth is the periosteum, or membrane which lines the socket of the tooth and envelopes its fangs.

At the period of decay just described, when the internal membrane is effectually destroyed, the tooth may be filled without producing the slightest pain during the performance of the operation, but its efficiency cannot be depended upon for the following reason.—In a vast number of cases, the morbid process which effected the destruction of the internal membrane, is now communicated to that part of the periosteum which surrounds the extremity of the fangs, and comes in contact with the blood vessels and nerves at their point of entrance into the tooth; the consequence of this is, the production and accumulation of a morbid matter which, so long as it has a free outlet through the cavity of the tooth, continues to ooze out, and is scarcely attended with any pain; but, should the orifice of the tooth be filled

under these circumstances, the matter having no means of escape, is confined within the part where it is secreted, and the process of suppuration being thereby in some degree obstructed, a great increase and extension of the inflammation of the periosteum, with acute suffering, and sympathetic swelling of the neighbouring parts, are the consequences. In this state of things one of two events takes place:—either the confined matter effects its passage through the substance of the alveolar process, and through the gum immediately opposite the point of the fang, by which it continues to discharge itself, and thus relieves the suffering occasioned by its confinement; or, it insinuates itself between the fangs and alveolar process, and forcing a vent by the neck of the tooth, produces the detachment and destruction of the periosteum. The latter frequently occurs, and the only relief that can be obtained under such circumstances is by the removal of the tooth. This being occasioned by the operation of filling injudiciously, it often brings discredit upon the operation, and prevents many from having recourse to it during the previous stages of decay, when its success would be certain and complete. Similar mischief occurs in grafting an artificial tooth upon a fang, if the operation be not timely and judiciously performed. In the former part of the work, I had occasion to explain the mode in which this operation is performed, when I stated the well known fact of that portion of the tooth engrafted being just as liable to decay as the living fang in

the gum to which the artificial crown is attached. I stated this fact amongst many others, which clearly proves decay of the teeth to be the result of chemical, and not of inflammatory action; and I shall now explain how it is that the operation of grafting a tooth often produces inflammation.

When, by the process of caries, the cavity of a tooth has been laid open, the internal membrane becomes inflamed, and disease supervenes, causing, in that part, matter to be secreted which escapes through the carious opening of the tooth; in such cases, if the cavity be plugged up by the insertion into it of the gold pin or pivot, the escape of the morbid secretion will be prevented, exactly as occurs after the improper filling up of a decayed tooth; the disease will extend to the periosteum, and inflammation will be excited in that membrane, which will become, in consequence, detached from the fang; or the confined matter will gradually force its way through the alveolar process and its external covering, and an abscess or gum boil will be produced. In doubtful cases of this kind, the safest plan is to insert the artificial tooth in a gold socket.

When the operation of grafting is resorted to, in a case in which the internal membrane of the tooth has not been exposed, and therefore not inflamed, and of course when the periosteum of the fang is still in a perfectly healthy condition, the application of the actual cautery to the internal membrane, and its consequent destruction, will prevent any diseased

action being communicated to the periosteum, and the operation will be quite successful.

Taking into consideration the great uncertainty of success in filling at this stage of the disease, a candid and skilful practitioner will in most cases recommend the extraction of the carious tooth, in preference to the trial of a remedy so doubtful, and frequently of so pernicious a tendency; and more particularly so in youth, when the removal of an imperfect tooth is of less importance, inasmuch as the vacancy will be filled up by the approach of the teeth on each side of it.

But there are circumstances under which the practitioner would be induced to try any expedient in order to save the tooth; as, for instance, when the principal support of one side of the mouth would be taken away by the removal of a molar tooth. If, however, under any circumstances, whether from the necessity of the case, or the importunity of the patient, the practitioner should be induced to resort to the operation of filling, as the last chance of preserving the tooth, he ought particularly to mention the possibility of its failure, and the probability of being compelled ultimately to extract the tooth.

I have found, from long observation, that the operation of filling so rarely succeeds, if delayed until the internal membrane of the tooth becomes exposed and inflamed, that there are but few cases, under such circumstances, in which I could be induced to try the experiment; for, where the result is not

attended with success, the pain is increased, and the evil aggravated.

In numberless instances of the above description, patients are constantly imposed upon by the false and delusive promises held out by empirics in their advertisements, who pretend by the application of their "mineral succedaneum," their "marmoratum," and their "anodyne cements," "to cure in one minute the most excruciating pain, and to form a whole tooth out of a stump." This is pure charlatanism, and yet how great is the number of individuals who are deluded by this mode of imposition. There is perhaps no other profession in which empiricism is so prevalent as in the department of dental surgery.

The very circumstance of sitting down to have a tooth extracted is attended with painful sensations, and the operation is certainly one of considerable severity, even when performed with the greatest skill; and although the suffering be but momentary, it is what most individuals naturally shrink from undergoing. Under this state of feeling the patient becomes the willing dupe of the charlatan, and is easily persuaded by him to try this or that nostrum, under the fallacious hope that relief may be obtained without being obliged to submit to the operation of having the tooth extracted. This mode of treatment may benefit the charlatan, but it only prolongs and aggravates the torment of the patient.

I am not an advocate for the extraction of teeth, where reasonable hopes can be entertained of pre-

serving them with utility to the patient ; but where there is no probability of doing this, is it not wise to submit at once to the extraction of the tooth, and by so doing to get rid of a diseased organ, which is not only useless itself, but is also an impediment to the usefulness of the neighbouring teeth, and a constant source of annoyance and suffering?

If we for one moment take into consideration the structure and formation of the teeth, we shall see that it would be quite as reasonable to expect that a man could exist in a state of health after a portion of his cranium had been removed, and the brain laid open to the direct action of foreign bodies upon it, as that a tooth should continue in a healthy condition and free from pain after an opening has been made through its enamel and bone, and the vascular membrane lining the internal cavity exposed to the influence of foreign bodies.

The pain necessarily attending the removal of a tooth may be very much lessened, in all cases, by a skilful performance of the operation. The art of extracting a tooth with the least possible degree of suffering to the patient, can only be acquired by a long course of practice and observation ; added to which, it is absolutely necessary that the operator should have a perfect knowledge of the anatomy of the parts ; that he should have instruments constructed upon the best principles, and the judgment to select the instrument best adapted for each individual case.

Some authors have laid down rules as to the particular method in which each tooth ought to be extracted. One is to be removed outwardly, another inwardly; the key instrument is to be applied in one case, and the forceps, etc., in another. I am, however, convinced that no general rule can be laid down which will be of utility in the performance of this operation; but that in the infinite variety of cases which occur, the operator must depend upon his own judgment and experience.

Of the different instruments hitherto invented for the extraction of the teeth, the key instrument and the forceps are decidedly the best. The principles upon which they are constructed adapt them, and particularly the key, for the great majority of cases, in which such instruments are used. Instances, however, must have occurred to every dentist in which the defects of these instruments would be brought forcibly under his notice; and various methods have been devised for remedying them in the key instrument. Here the defects are of two kinds, and both depend upon the very construction of the instrument itself. The first is the difficulty of so adapting it, in different cases, that the point of the claw shall always be nearly opposite to, but rather above the centre of, the fulcrum; but if the fulcrum and the tape, or other material wrapped round it, be too small, the point of the claw will descend too low towards the neck or fang of the tooth, and there will be great risk of breaking away a considerable portion of the

alveolar process; whereas, on the other hand, if the fulcrum or bolster be made too large, the point of the claw will not descend sufficiently low, and in attempting to extract the tooth, its crown will almost certainly be broken off. This nice adaptation of the size of the fulcrum to each tooth to be extracted, depends entirely upon the practised eye of the operator; and this difficulty, therefore, can only be overcome by long experience.

The second defect is the impossibility of applying power to the instrument in more than one direction, which is a lateral one; for if, after the claw has been properly fixed, and the tooth been partly detached by the instrument, we attempt to change the direction of its line of action, and draw the tooth perpendicularly, as with a pair of forceps, the claw will inevitably move from the situation in which it had been placed, and loose its hold of the tooth altogether.

The defects of the forceps may be very briefly noticed. If the tooth be very much decayed, and an attempt be made to extract it with this instrument, the force necessary for its removal, unless it be very loose, will be such that the walls of the carious part will be crushed together, and the fangs remain in their sockets. If the crown of the tooth be entirely removed by caries, and the fangs on a level with the edges of the alveolar processes, there will be no hold for the forceps. Knowing that these difficulties must often occur in using the key instrument and forceps, particularly when in the hands of individuals who

have not had very considerable experience in the performance of this operation, I was induced to think that another instrument might be constructed which should combine in itself all the advantages contained in each of these separately, and at the same time should be free from all their defects. This I accomplished some time ago, and after several years' experience in the use of this instrument, I have found it more than equal to my most sanguine expectations. It is represented in Plate VI., and its construction may be thus briefly described.—It consists of two parts which move on a hinge, in the same plane, but, of course, in opposite directions; the extremity of one is a fixed fulcrum, and to the end of the other is attached a fixed claw, so that the point of the claw is in all cases opposite to the same point of the opposing fulcrum. From this construction of the instrument, it will be evident that no difficulty can ever arise from any difference in the size of the tooth to be extracted; while, at the same time, from the circumstance of the operator having the power of regulating the exact degree of force with which the claw shall be held against the tooth, it is also evident that the instrument may be used as a pair of forceps, and consequently is applicable to all cases, whether the tooth be only slightly carious, or so much decayed as to be on a level with the gums, or alveolar processes.

CHAPTER V.

BAD EFFECTS WHICH RESULT FROM RETAINING
DISEASED TEETH, WHICH ARE BEYOND THE
POWER OF REMEDIAL MEASURES.

I SHALL now proceed to notice some of the consequences which result from retaining a carious tooth which cannot be filled, and allowing it to take its course through the future stages of decay.

First.—The disease proceeds from one stage to another, gradually increasing in rapidity as the morbid cavity enlarges and becomes more capable of receiving and retaining a greater quantity of corrupting matter, until the whole crown of the tooth is destroyed, and broken down to a level with the gums. At this period the progress of decay becomes less rapid upon the remaining parts of the tooth; for the surrounding walls, which formed this receptacle, being removed, the surface is comparatively smooth, and the food is less liable to be retained, and to undergo chemical change; the disease, however, does proceed, and only terminates with the destruction of the last remains of the fangs.

Secondly.—While the process of decay, which we have been describing, is going on, the breath of the

individual is rendered offensive by the putrid substances accumulated in the hollow of the tooth,—an effect which is too often attributed to derangement of the stomach, or other imaginary causes.

Thirdly.—At this stage of caries, the periosteum of the tooth is always more or less tender, susceptible of inflammation, and liable to be excited by every local or constitutional cause, so as to prevent the use, not only of the tender tooth, but of the whole of the neighbouring teeth, in the process of mastication.

Fourthly.—When mastication is confined to one side of the mouth, a deposition of tartar is liable to take place on the teeth in disuse, the friction of the food having a direct tendency to prevent its accumulation on the teeth employed in mastication; the teeth in use will accordingly be comparatively free from this concretion, while those of the opposite side are incrustated with it to a considerable degree. The pernicious effects of this deposit we shall have occasion hereafter to explain.

Fifthly.—When the carious portion of a decayed tooth comes in apposition with the side of a sound one, the disease is communicated to the latter by the corrosive action of the putrid substance contained in the former.

These are the most usual occurrences that result from the retention of carious teeth. But other cases have come under my notice, and they are by no means uncommon, in which inflammation of the periosteum of those teeth situated immediately under

the antrum or cavity of the cheek bone, has been communicated to the membrane which lines that cavity, thereby producing a disease of a very serious character, sometimes occasioning an exfoliation of a portion of the bony walls which compose it; in other cases, exfoliation of large portions of the alveolar processes, and occasionally of a part of the jaw bone itself. Another bad consequence results from retaining diseased molar teeth in the lower jaw, and more especially the *dentes sapientiæ*; this is the liability to the occurrence of abscesses externally at the under edge and angle of the jaw, which are sometimes difficult to be healed, and always unpleasant in their consequences.

I have already stated that when suppuration has taken place in the periosteum of a tooth, the confined matter generally effects a passage through the alveolar process, immediately opposite the point of the fang. The bony walls which enclose the roots of the teeth under consideration, being much thicker than those of the other teeth, the accumulated matter cannot find so easy a passage in that direction; and besides, the central portion of the jaw bone, into which the fangs of these teeth dip, being of an open and porous structure, the confined matter, having a natural tendency to sink, often accumulates in this situation, and finds an easier outlet through the base of the jaw, and its external coverings.

In the most favourable cases of abscess thus produced, scars always remain after healing, exactly

resembling in appearance those of scrofula. In some cases, however, the process of healing is rendered tedious by the exfoliation of bone destroyed by the purulent matter during its confinement. It is obvious that these consequences can only be effectually prevented, and the diseased process which led to them put a stop to, by the removal of the primary cause, namely, the decayed tooth: and here I may remark, that not only in this, but in every case, where inflammation and suppuration have arisen from such causes, the most speedy, safe, and decisive remedy, where it is practicable, is the immediate extraction of the tooth, thereby making a free outlet for the confined matter. This is often objected to, from a mistaken prejudice, that some injury would be sustained by the removal of the tooth before the subsidence of inflammation; upon this principle the case under our notice is treated by hot applications externally, thereby softening the parts, and inducing the abscess to break outwardly, which ought by every means to be prevented. The mischief would be avoided by the removal of the tooth, and the only bad effect resulting from the operation would be the experience of somewhat more pain, in consequence of the inflammation of the surrounding parts.

The dentist is not the only individual who ought to be well acquainted with the cause of the destruction of the teeth, and the nature of their diseases; it is equally important that the physician and surgeon

should have a correct knowledge of the subject, so as to be able to discriminate between pain arising from these organs, and pain arising from other causes; for, in the absence of this knowledge, we find that pain proceeding from the teeth is often confounded with, and mistaken for, other complaints.

When the membrane of a tooth becomes exposed and inflamed, the pain is often felt in the remotest parts of the face, and the seat of the disease is therefore supposed to be in the ear, the temples, or some of the neighbouring parts; whereas, upon a skilful and minute inspection of the teeth, the exciting cause of the pain may be traced to the exposed and inflamed membrane of one or more of these organs.

Pain arising from inflammation of the membranes of the teeth is, in numerous instances, attributed to a complaint called "neuralgia," or "tic douloureux;" consequently the patient is doomed to suffer for months, and sometimes for years, while he is undergoing a course of useless treatment, in the hope of obtaining relief from this imaginary disease.

During a period of twenty years' practice, I have met with many supposed cases of tic douloureux; but experience bids me to declare genuine tic douloureux to be a complaint of rare occurrence. It is said to be a complaint that generally attacks the face, and occasions a painful affection of the nerves, particularly of that branch of the fifth pair which comes out of the supra-orbitary foramen; it is said to be different

from all other affections, and to be distinguished by the shortness of the paroxysms, and the rapidity of their succession; that during the interval there is an entire freedom from all pain; and that the seat of the pain, and its darting in several directions, according to the particular nerve affected, differs in acuteness and poignancy from that of the toothache. During a long and extensive practice, I have met with but few cases of the nature above described that could not be traced to the teeth; but, hundreds of supposed cases of neuralgia have come under my notice. I should therefore in every instance of supposed tic douloureux, when the pain occurs in the face, in the neighbourhood of the teeth, which is generally the seat of the complaint, strongly recommend a careful and minute inspection of every tooth in the mouth; and I feel assured that in ninety-nine cases out of a hundred of supposed tic douloureux, the pain will be found to proceed from one or more of the teeth.

One tooth with its membrane exposed and inflamed is of itself sufficient to produce the most violent paroxysms of pain; and until this evil be removed, why attribute the pain to another cause? We sometimes meet with instances where the patient has not less than half-a-dozen teeth in a state of disease, each of which is capable of producing all the pain complained of; nevertheless, a case of this description is often pronounced to be one of tic douloureux, and treated as such.

In all supposed cases of tic douloureux, the teeth

should be carefully inspected, and if there should be no decay found upon the exposed surfaces of the teeth, likely to occasion the pain complained of, we are not even then to come to a hasty conclusion by pronouncing it a case of *tic douloureux*. Decay very often takes place upon the surfaces of the teeth which are not exposed to view, on their lateral sides, particularly those of the molar teeth,—situations which, from their position, cannot be observed by merely looking into the mouth; but by carefully searching round the interstices of these teeth with a bent probe adapted for the purpose, a cavity will be found, and there the seat of the mischief will be detected.

When pain proceeds from the teeth it must either arise from inflammation of the internal membrane, or from inflammation of the periosteum; and in both cases outward signs present themselves to the notice of the experienced practitioner, which will be sufficiently obvious to point out the seat of the disease. As long as the internal membrane of a tooth is protected from the influence of foreign bodies, by the surrounding enamel and bone, it is not subject to pain; and it is only when caries has penetrated through these substances to the centre of the tooth, and laid open the membrane there contained to the direct influence of external irritants, that inflammation is produced.

Sometimes the teeth become worn down by friction, and in this way the membrane is exposed; but we are never to conclude that the internal

membrane is in a state of disease in the absence of these external causes. I have never met with an instance of the kind.

I mention these external appearances connected with diseased teeth, in order that they may be distinguished from teeth in a healthy state, and that the latter may not be sacrificed uselessly, and instead of the former, which is too often the case. It is natural to suppose that the judgment of the sufferer might be relied upon, and that he would be the most likely to point out the tooth from which the pain proceeds; but this is not always the case; and if we were at all times to be guided by his judgment and feeling, and extract the tooth which he believes the pain to proceed from, mistakes would very often be committed. The patient is not only liable to fix upon a wrong tooth in the neighbourhood of the painful one, but he often supposes the pain to proceed from a tooth in the upper jaw, when it arises from one in the lower jaw, and *vice versa*. This is a circumstance which very often happens; but I may mention one of a singular kind that occurred about twelve months ago, which shows the effect of the imagination in procuring temporary relief from toothache.

A medical gentleman of this town called upon me in consequence of having suffered severely from toothache. Before examining his mouth, he informed me that the pain arose from the first molar tooth on the left side in the upper jaw, that it came on

in violent paroxysms, that he had been suffering for nearly a week, that he had been applying kreosote (or the extract of tar) to the tooth, and that it was astonishing the instant relief which it gave; but that the pain after a short time returned, and that he was at last resolved to have the tooth removed.

Upon removing the kreosote, and examining the suspected tooth, I found it perfectly sound, and free from disease. My attention was then directed to the adjoining teeth; they were also free from disease. In short, he had an excellent set of teeth; and the only tooth in his mouth capable of giving pain, was the first molar tooth in the lower jaw, instead of the first molar tooth in the upper jaw, as he suspected.

Upon announcing this fact to him, he seemed very much astonished, and looked as if he rather doubted the truth of my statement. He thought I must be mistaken; that it could hardly be possible that his feelings could mislead him so far as to fix upon a tooth in the upper jaw, if the pain proceeded from one in the lower jaw; and again, he could not account for the relief from pain obtained by the application of the kreosote to the wrong tooth. After directing his attention to the tooth from which the pain arose, I recommended him to defer the operation of having the tooth removed until the following morning, not doubting that before that time he would feel satisfied that the decision I had come to was a correct one. He returned the next morning and informed me that he had suffered con-

siderably during the night, and that he was now perfectly convinced that the pain proceeded from the tooth in the lower jaw, and not from the one in the upper jaw, as he had supposed. He had the tooth immediately removed. It is twelve months ago, and he has suffered no pain since.

In a case of this description, there can be no difficulty in fixing upon the diseased tooth; for, as I have before stated, it was the only one in the mouth that could be suspected. But it often happens that there are several carious teeth in the mouth, and then it becomes difficult to fix upon the one which is the immediate cause of the pain. The experienced practitioner overcomes this difficulty in a great degree. Where the membrane of the tooth has become inflamed, and suppuration taken place, the carious cavity of the tooth presents an appearance which he can hardly mistake, although there may be some difficulty in describing it. When suppuration takes place in the internal cavity of a tooth, the accumulated matter either finds a passage through the carious opening of the tooth, or by the ducts which enter at the points of the fangs. If, through the former, the decayed portion becomes saturated with this matter, and partakes of its colour; if through the latter, the periosteum becomes inflamed and thickened; the tooth appears rather loose in its socket, and is painful to the touch.

“Whenever any doubt is expressed,” says Mr. Fox, “great caution should be observed previously

to the extraction of the tooth. The teeth may be examined by striking them with the end of a pair of forceps, in order to discover that which is the most tender; as it usually happens that a tooth in a state of inflammation is so sensible, that it will not bear to be struck without pain." This mode of examination is by no means satisfactory; for, as long as inflammation is confined to the internal membrane, the striking of the tooth will not produce pain; it is only when inflammation has extended to the periosteum that pain can be produced by striking the tooth, and in this case it is unnecessary; for the slightest touch with the finger will be sufficient to occasion pain, from the pressure of the inflamed membrane between the socket and the fang of the tooth. There is another mode of examination recommended by the same author; it is rather a barbarous one, I admit, although it is necessary sometimes to have recourse to it; and it is by introducing the point of a bent probe into the decayed hollow of the tooth, and touching the inflamed membrane. But this is an operation which is attended with nearly as much pain as would be experienced by the extraction of the tooth, and should therefore be avoided, excepting in cases where it becomes absolutely necessary.

There is another mistake which the generality of people make. They have an idea that the greater the destruction of the tooth by caries, the more likely it is to produce pain; and they constantly fix upon a tooth

of this description as the source of the pain, and overlook the one which is the cause of the suffering, because it appears a sounder tooth than its fellow. When decay has made considerable progress, so as nearly to have destroyed the whole of the crown of the tooth, the pain ceases; because the internal membrane of the tooth also becomes destroyed, in consequence of having been so long exposed, and the only part connected with the tooth capable of producing pain, is the periosteum, the membrane which lines the socket and envelopes the fang; but this membrane, when it becomes inflamed, never occasions so acute pain as that which is produced by inflammation of the internal membrane; and it is readily detected, as I have before stated, by the thickening of the periosteum, and the loosening of the fang.

The pain from a carious tooth is the most acute at that period when decay has just exposed the internal membrane; when perhaps the carious part would scarcely admit the head of a small pin; the blood vessels within the teeth are then in full vigour, and when they become inflamed and glutted with blood, the nerves in juxta-position with them are forced against the surrounding and unyielding walls of the tooth, and the pain produced is excruciating. In all cases of this description there is no remedy but the extraction of the diseased tooth. The application of blisters or leeches to the neighbouring parts, for the purpose of subduing the inflammation, is altogether useless. The vessels which convey the blood to the cavity

of the tooth are so deeply seated in the jaw bone as not to be influenced by the abstraction of blood at the surface of the surrounding parts; and the only temporary relief that can be obtained is from hot or cold applications. The former may sometimes be serviceable, by relaxing the vessels, and causing a freer circulation of the blood through them; the latter, by decreasing the flow of blood to the inflamed vessels; but, in the most favourable cases, the relief is but temporary, and even that cannot always be obtained.

When the internal membrane of a tooth becomes exposed and inflamed, it has no power of recovering itself; the carious opening into the tooth remains; the bone and the enamel have not the power of restitution; the membrane therefore continues exposed and unprotected, and is constantly kept in a state of excitement by foreign bodies coming in contact with it. If, under these circumstances, filling were to be introduced into the cavity, it will appear obvious that the filling would come in contact with the membrane, and the pressure and irritation which this would occasion would produce pain of the most violent description.

When the membrane of the tooth becomes exposed and inflamed, the better way is to have the tooth removed at once; and here it may be proper to obviate some objections to the extraction of teeth irremediably diseased, which are very commonly entertained by individuals who ought to be better informed,

and in whom such misconceptions could not be expected; namely, that there is no end to the extraction of teeth when once begun; that when one tooth has been removed, a short period only will intervene before more will require to undergo the same operation; that the removal of one tooth takes away the support from the adjoining one, thereby in some way predisposing it to decay; and also that the opposite tooth is liable to decay from some imaginary loss sustained by the extraction of the other, or from some mysterious sympathy.

It is very true that the teeth often decay in the manner just described; but it proceeds from very different causes to those brought forward by these objectors. The cause of the decay of the teeth in pairs has been already so fully explained, that it is unnecessary here to say more, than that their liability to decay at or about the same period of time is owing to the similarity of their structure, and to their being in like manner formed so as to retain particles of food; and that the circumstance of one requiring the operation of extraction soon after another, does not depend upon any imaginary sympathy, nor upon any effect produced upon one tooth by the removal of its fellow, but arises from the fact that the former was already in a state of progressive decay when the latter was removed.

The allegation that the extraction of one tooth takes away the support from the adjoining teeth, and thereby predisposes them to decay, is equally erroneous; for

when decay takes place on the contiguous sides of two teeth, they will be found to come in contact with each other towards their cutting points, and to diverge towards the gum, so as to adapt them for intercepting food in that situation; but the side of one is often more liable to this on account of its having a neck or groove calculated to retain a greater portion of the putrid substance; (see Plate II., fig. 5, *l*, and Plate III., fig. 2, *c*, as compared with Plate III., fig. 1, *a*;) the consequence of which is, that it will be sooner acted upon, and will proceed with greater rapidity to that stage of decay in which the membrane is exposed and inflammation excited, so as to render its removal necessary on account of pain, long before the other has arrived at the same stage.

The removal of a carious tooth is so far from being the cause of decay in the adjoining one, that it is oftentimes the cause of effectually and permanently retarding its progress after it has commenced, by removing the contact between them, which gave occasion for the lodgment of food; this occurs when the operation of extraction has been performed before the disease has passed its first stage, when the putrid substance has only blackened the enamel upon the side of the adjoining tooth, and when no cavity has been produced; under these circumstances decay proceeds no farther, the discoloured portion of the enamel undergoes no change, and the tooth is saved. This is a case so obvious, and of such frequent occurrence, that it can scarcely be overlooked, even by the most

superficial observer; a demonstrative proof of the correctness of the theory advanced in these pages—that the disease commences upon the surface, and is excited by external agency, and that it does not originate in the interior of the tooth, nor upon the surface of the bone within the enamel. When, however, the disease has reached the second stage, and a cavity has been produced before the removal of the tooth, which by its contact formed the interstice that retained the food, the cavity produced will of itself, even after the removal of the original cause of mischief, be sufficient to allow a deposition of food within it; and consequently will, if not remedied by the operation of filling or filing, proceed to that stage of decay when it will also require to be extracted.

CHAPTER VI.

LOSS OF THE TEETH FROM TARTAR, AND FROM
INFLAMMATION OF THE PERIOSTEUM.

IN the preceding pages I have described the cause of decay in the teeth, and traced its progress; but the loss of the teeth is occasioned by other causes besides the exposure of the internal membrane. The tooth depends for its support upon a healthy state of the periosteum, or membrane which lines its socket, and envelopes its fangs; the exposure and inflammation of this membrane is of itself sufficient to occasion the loss of the tooth. As the internal membrane is protected from the influence of foreign bodies by the enamel and bone which surround it, so the periosteum is protected from the action of external causes by the firm adhesion of the gums to the necks of the teeth; therefore a healthy state of the gums is absolutely necessary to ensure the safety, comfort, and durability of the teeth; and if all the consequences arising from an unhealthy condition of the gums, the alveolar processes, and the periosteum, be taken into account, we shall find that the loss of the teeth occasioned by disease in these parts is very considerable.

There is such connexion and sympathy existing

between the gum, the socket and the periosteum, and such mutual dependence upon each other for support, that the one cannot exist without the other. For example.—When the periosteum is destroyed, which it necessarily is by the extraction of a tooth, absorption immediately takes place in the socket and gums; on the other hand, the receding of the gums from the necks of the teeth is always accompanied with absorption, to the same extent, of the alveolar process and periosteum. When inflammation is excited in either of these parts, the others also become diseased; but the mischief generally originates in the gums, and in the greater number of cases may be attributed to the want of cleanliness, and to omitting the use of the tooth brush.

The loss of the teeth from disease in these several parts is occasioned in three different ways.—In the first place, the receding of the gums, from a cause which will be presently explained, renders the teeth liable to caries by producing openings between them, (Plate III., fig. 4,) which admit of their retaining portions of food; whereas, in a regular and well arranged set of teeth, the gums, which have been kept in a healthy state, not only adhere firmly to the necks of the teeth, but send forth processes which fill up their interstices, (Plate III., fig. 3,) and thus prevent the retention of food. And here it is of the utmost importance to impress upon the mind of the reader the irremediable nature of the mischief which is occasioned by neglecting to keep

the gums in a healthy condition; for, when once disease has been excited in the gums, so as to detach them from the necks of the teeth, to whatever distance they may have receded, the injury, so far sustained, is irremediable; the vital connexion which previously existed between the now denuded portion of the fang and the gum, through the medium of the periosteum, is destroyed by the exposure; the gums cannot be brought back to their original situation; the evil is therefore permanent.

Secondly.—The loss of the teeth is often occasioned by acute inflammation of the periosteum, terminating in suppuration, the result of which is the separation and destruction of this membrane, by which the tooth is severed from the socket, and is thus deprived of its support. It frequently, however, becomes necessary to remove the tooth in consequence of the pain produced by the inflammation of its periosteum; and this membrane, thickened by the inflammatory action, often raises the tooth above the level of the others, and occasions great pain through the consequent pressure against the opposing tooth in closing the mouth, and during the process of mastication. I have before stated that, when caries has exposed the internal cavity of a tooth, and excited inflammation in its lining membrane, the disease is often communicated to the periosteum; but in the case now spoken of, an unhealthy state of the gums is the exciting cause, and the loss of the tooth is effected without the existence of decay.

Thirdly.—The teeth are liable to become loose and to fall out spontaneously in consequence of the gradual absorption of the gums, the alveolar processes and the periosteum, by which they are deprived of their support. This morbid process is unaccompanied by acute pain or inflammation of the parts, and is merely attended with a spongy, loose, and irritable state of the gums.

The principal exciting cause of the disease above mentioned, is the accumulation of a calcareous substance, called “tartar,” which is deposited upon the necks of the teeth. This earthy matter is originally contained in the saliva, by which it is held in solution, and consists principally of the phosphate of lime. When it first attaches itself to the teeth it is of a soft and slimy consistence, being combined with the thicker and more glutinous parts of the saliva; but when it has been allowed to remain upon the teeth for a certain period, the watery parts separate from the earthy matter, and the substance left becomes extremely hard. The teeth of every individual are more or less liable to this concretion; but those of some persons are particularly subject to it.

The parts where the deposit first takes place are those which are the most exempt from friction during the process of mastication; this is apparent from the fact that, when mastication is confined to one side of the mouth, which is often the case, in consequence of the presence of a diseased and tender

tooth on the opposite side, the teeth employed in mastication are comparatively free from the concretion, while those in disuse are often incrustated with it to a great degree. The necks of the teeth being most exempt from the friction of the food, and the action of the surrounding muscles, they are accordingly the parts on which tartar first begins to concreate; and moreover, in these situations it finds a resting place in the furrows produced by the abrupt termination of the enamel, and the free edge of the gum.

A deposit once established, forms a basis for a further deposition, and, one layer being successively added to another, the accumulation goes on gradually increasing and insinuating itself below the edges of the gums, thereby detaching them from their connexion with the necks of the teeth, and at the same time producing an irritable and spongy state of these parts, which are subject to bleed upon the slightest application of the tooth brush.

As the tartar increases in quantity, it progressively takes possession of more and more of the fang, causing the gum, the socket, and the membrane, to retreat before it until it excites inflammation in the periosteum, and then, in consequence of the acute pain occasioned, the tooth must be extracted; or, should this not be the case, the tartar takes possession of the whole of the fang, and then the tooth, losing its support, drops out of itself.

The saliva naturally occupies the lower part of

the mouth, consequently the front teeth of the lower jaw are the most subject to the injurious effects of this concretion; and although these teeth, as we have before stated, are the least liable to caries, they are the most subject of all the teeth to be lost from the pernicious effects of tartar.

Having pointed out the bad consequences of an accumulation of tartar upon the teeth, our next object is to show how the mischief may be prevented.

When this substance is first deposited upon the teeth it is of a soft but glutinous consistence, and may, in all cases, be removed by the firm application of the tooth brush, with the assistance of a safe and well prepared tooth-powder; in some cases, indeed, in which there is but little tendency to its accumulation, and when it is naturally less tenacious, the tooth brush and water alone are sufficient to prevent a deposition from accumulating to an injurious degree; but in most cases the friction of the tooth-powder is absolutely necessary; and to accomplish this object the teeth ought to be thoroughly cleansed once in twenty-four hours; for, if this substance be allowed to settle upon them, it becomes exceedingly hard, and cannot be dislodged by the process of brushing.

The use of acids under these circumstances is sometimes resorted to by ignorant and thoughtless individuals, for the purpose of removing this concretion;—a practice which cannot be too strongly reprobated on account of the ruinous effects which

result from it. An acid sufficiently powerful to destroy the tartar must at the same time operate upon the enamel of the tooth, the earthy part of both substances being phosphate of lime.

It may here be observed, that when it is necessary to have recourse to medicine containing much acid, it is advisable to take it through a glass tube, as frequently practised; and by this means to save the teeth as much as possible from coming in contact with the medicine; by this simple precaution considerable mischief may be prevented.

The destruction of the teeth, however, is very often attributed to the effects of medicine, but without the least foundation, and when the origin of the injury may be traced to a different cause.

The effect produced by acids upon the teeth, and that produced by caries, are distinguished by very different characters; the latter is partial in its attacks, being confined to those teeth and the parts of them which retain food, so that one tooth may be diseased and the adjoining tooth perfectly sound; with the former it is quite the reverse; the effect produced is apparent upon the whole range of the front teeth which come in contact with the acid, and those parts of them too which are the least subject to decay, namely, their smooth front surfaces.

During a protracted illness, where much medicine has been administered of the description before alluded to, I have seen the whole range of the front teeth, including the incisores, the cuspidati, and the bicus-

pides, denuded of their enamel from their necks half way to their cutting edges. The enamel is thinnest at the neck, and thickens gradually towards the cutting edge of the tooth, which accounts for the part described becoming sooner dissolved from the effects of the acids.

But to return to our subject.—When tartar has been allowed to accumulate upon the teeth until it acquires a hard consistence, and is no longer capable of being dislodged by the process of brushing, it ought to be removed with the small instruments adapted for that purpose; and it is of importance to remove every particle of it, for if the smallest portion of it be allowed to remain, it will form a basis for a further deposition.

After the operation has been performed, the daily use of the brush, with a proper tooth-powder,* is necessary for the purpose of removing the viscid matter in which the tartar originates. An accumulation of tartar upon the teeth is invariably attended with a loose, irritable, and spongy state of the gums; and to restore these parts to a healthy condition after the tartar has been removed, (for it is impossible to do so while this substance is allowed to remain,) I know nothing more effectual than tincture of myrrh diluted

* The tooth-powder which I use and recommend is, "Blair's Tooth-powder." It is well prepared, and contains no ingredient which is injurious to the teeth. This is more than can be said of a gritty tooth-powder, or of a tooth-powder containing acid, which is sometimes introduced for the purpose of whitening the teeth. Tooth powders of this description ought not to be used.

with two parts of water. This mixture should be firmly brushed into the gums: merely rinsing the mouth with it is not sufficient.

And here I would observe, that a very mistaken notion prevails regarding the treatment necessary to keep the gums in a healthy condition, and also regarding the treatment which is required to restore them to a sound state when diseased. Many persons have an idea that the gums are in danger of being removed from the necks of the teeth by the firm application of the tooth brush; consequently the brush is used very slightly, and therefore very ineffectually; and the result is, an accumulation of tartar, occasioning irritation in the gums, which become painful and subject to bleed, even from the gentle treatment I have been describing. In this state of things, brushing is either dispensed with, or performed in a manner which is altogether useless.

To preserve the gums in a healthy state, the teeth must be kept clean. To restore them to a healthy state when diseased, the exciting cause must be removed, and for the future the teeth must be kept clean. This can only be accomplished, in most cases, by the thorough application of the tooth-brush, with the assistance of tooth-powder. There is not the least danger of brushing the gums from the necks of the teeth; on the contrary, that degree of brushing which is necessary to keep the teeth clean will be found beneficial to the gums; and by a continuation of this mode of treatment they become every

day less irritable and less subject to bleed upon the application of the brush, till at last they acquire a healthy action, and adhere tenaciously to the necks of the teeth. The use of the tooth-powder is to prevent an accumulation of tartar, not to remove it; for when once this substance has been allowed to settle upon the teeth, it is no longer capable of being removed without the aid of instruments. This process is what is generally termed "scaling the teeth,"—a phrase which no doubt derives its origin from the circumstance of this earthy incrustation being separated from the teeth during the operation, in the form of scales.

Mistaken notions exist in the minds of some individuals respecting the removal of tartar from the teeth, which they imagine must be attended with mischievous consequences; such as, that the enamel sustains an injury which predisposes the teeth to caries, or that they are in danger of being loosened by the operation. This prejudice, like many others, may, I doubt not, be traced to the untimely and injudicious performance of the operation. There are instances where the tartar has been permitted to remain upon the teeth for so long a period, and to accumulate to such a degree, that the sockets and gums have receded to the extreme points of the fangs, and the teeth being retained in their situations principally by the support of this substance, which cements one tooth to another; the removal of it, under these circumstances, would certainly occasion

their loss rather sooner than would have been the case if left to their own course; but no skilful practitioner would attempt performing the operation under such circumstances, as he would immediately perceive a case of this nature to be irremediable. On the other hand, the timely removal of the tartar, before the greater portion of the fang has been taken possession of, and the daily use of the brush and tooth-powder, for the purpose of preventing a future accumulation, will permanently arrest the mischief; and although the denuded part of the fang can never be restored to its original state, the link of union between it and the gum being dissolved, (in consequence of the destruction of the periosteum, and the absorption of the alveolar process, to an extent equal to the exposure of the fang,) yet the remaining portion of the periosteum, and the surrounding parts, will continue in a healthy condition, and a sufficient hold will still be left in the socket to secure the tooth in its situation.

Having pointed out the injurious effects which result from an accumulation of tartar upon the teeth, and having shown how readily the mischief may be prevented, I presume it is scarcely necessary to add a single remark further upon this subject; taking it for granted that the reader must be convinced of the absurdity of the prejudice, which supposes that the teeth sustain injury from the removal of this extraneous substance, and also that ignorance of the evil will no longer form an impediment to the means of prevention.

Should the advantages which the individual would himself derive not be a sufficient inducement to prompt him to adopt and persevere in the treatment recommended, a regard for the feelings and comfort of those about him ought surely to urge him to the propriety of divesting his teeth of this offensive and unsightly concretion; for what can be more disgusting to those who consider cleanliness an essential, than to be doomed to enter into anything like close conversation with a person whose teeth are incrustated with this fetid accumulation.

I have now fully explained the nature and progress of the two destructive diseases to which the teeth are liable, namely, caries and tartar; by the corrosive action of the former, an opening is effected through the enamel and bone which surround and protect the internal membrane, thus exposing it to the influence of foreign bodies which necessarily excite inflammation in this part, and occasion the destruction of the tooth; by the instrumentality of the latter, the gum is forced from the neck of the tooth, thus, depriving the periosteum which envelopes the fang of its natural covering, and exciting inflammation in this membrane, so as to require the removal of the tooth in consequence of the pain produced, or otherwise causing gradual absorption of the surrounding parts, until the tooth becomes so loose as to drop out.

These are the evils to be guarded against; and if it were possible to keep the teeth perfectly free from tartar, and to remove the particles of food from their

indentations and interstices before a chemical change takes place, much suffering would be prevented. Gum boils, abscesses, and exfoliation of the alveolar processes, are, almost in every instance, the results produced by one or other of the two primary evils above mentioned; and for such diseases there is no cure but that of the removal of the exciting cause, namely, the diseased tooth.

Having, I trust, succeeded in making the reader acquainted with the true causes of the destruction of the teeth, he will now see a necessity for that careful and constant watchfulness over these organs which I have recommended; and he will also see that he has the means of preserving them from the only destructive diseases to which they are liable, namely, caries and tartar.

CHAPTER VII.

POPULAR BUT ERRONEOUS NOTIONS CONCERNING THE CAUSES OF THE DESTRUCTION OF THE TEETH ALLUDED TO, FOR THE PURPOSE OF CORRECTION.

IN this chapter I shall allude to a few of the erroneous notions which in many instances continue to be entertained, regarding the teeth and the causes of their destruction. I shall merely allude to some of these for the purpose of correcting them.

The great error into which the most popular writers upon the diseases of the teeth have fallen, and from which many other mistakes have originated, is, their having overlooked the peculiarity of structure and organization of the teeth, as compared with the other parts of the body. Hence, they have very naturally supposed that the destruction of the former proceeded from the same cause as the destruction of the latter; consequently the principle of treatment in both cases has been similar. In the former part of this work I have shown that the structure and organization of the teeth are altogether different from other bones, and that they are neither formed after the same manner nor governed by the same laws.

In the former part of the work, I have noticed the theory of Mr. Bell, and contrasted his views with my own; but here, under the head of erroneous notions, I think it necessary to make a few remarks on the treatment recommended by him as a preventive to decay; treatment naturally arising out of his theory, and quite in unison with the mistaken notions which he entertains of the exciting cause of caries of the teeth.

“In the first place,” Mr. Bell recommends that, “fluids should never be taken into the mouth, or at least should never be applied to the teeth, either so hot or so cold as to produce the slightest pain; and for the same reason, the water with which the mouth is cleansed, should in the winter, be always warm or tepid. When from any of the causes before mentioned, a certain degree of inflammation is set up in any of the teeth, it should be immediately reduced by the application of leeches to the gum, as near as possible to the part in pain; and, if necessary, this should be repeated, and the bleeding encouraged by holding warm water in the mouth. It is perhaps seldom that this measure is had recourse to, sufficiently early to prevent subsequent injury, either from ignorance, or want of attention to the probable consequences; but I have no doubt that if the plan now recommended, were adopted in an early stage of the inflammation, this result would in many instances be prevented. As a general rule, leeches should be applied

to the gums, whenever pain exists in an apparently sound tooth.”*

When one or more of the teeth are decayed so as to leave exposed, or nearly exposed, the internal membrane; when several of the teeth have been filled or filed at that stage of decay when there is only a very thin portion of bone left to protect the internal membrane; or when the gums have receded from the necks of the teeth and partly exposed the periosteum, the taking of hot or cold water into the mouth will certainly produce “slight pain,” and to avoid this it is better that the water with which the teeth are cleansed should be “warm or tepid.” Also, when the periosteum of a front tooth becomes inflamed, either from the receding of the gums or from previous decay in the tooth, by the application of leeches the inflammation may sometimes be subdued; but that all this should be recommended as the means of preventing decay of the teeth, shows ignorance of the exciting cause of caries.

When the teeth are tender I do not object to the use of warm water, I recommend it;—likewise in many instances it is necessary to use it with the tooth-powder, when the teeth are difficult to keep clean; for some people’s teeth are much more difficult to keep clean than others, and warm water for this purpose is better than cold. Neither do I object to the application of leeches when the periosteum, particularly of a front tooth, becomes inflamed, although much

* Bell, page 136.

benefit is not to be expected; but I do object to the public being deceived by being led to suppose that inflammation is the exciting cause of caries, and that by adopting this mode of treatment, they are preventing, or subduing inflammation, and consequently, preserving their teeth from decay.

If inflammation were the exciting cause of caries of the teeth, as Mr. Bell supposes, the treatment here recommended would be judicious; but I have proved that inflammation is not the exciting cause of decay in these organs; consequently I consider his precautionary measures altogether useless. Moreover, the pain and inflammation which he supposes to occur in the teeth previously to the commencement of decay, do not take place. It is true that his theory requires that this should be the case; but it is all imaginary on the part of Mr. Bell, for we know from experience that decay begins and proceeds through several stages without the slightest feeling; and it is to this very circumstance that the loss of teeth, which is so very general, must be attributed.

I ask any dentist of experience to note the number of patients that consult him under similar circumstances to those alluded to by Mr. Bell. I ask him how many cases he has during the year where he finds his patients suffering from inflammation as the precursor of decay in the teeth, and where upon minute examination, the teeth are found to be perfectly free from decay? For my own part I must confess, that during a long and extensive practice, I have

only met with two or three cases of the nature which Mr. Bell describes, where the patients complained of pain, and when decay in the teeth could not be detected; and those cases I have put down under the head of *tic douloureux*.

But in order that I may be correctly understood, I must here remark what I have before stated, that inflammation of the periosteum of a tooth, is not to be confounded with, or mistaken for, inflammation of the internal membrane, for the periosteum, from the receding of the gum and from other causes, often becomes inflamed, and in many instances it is necessary to remove the tooth in the absence of decay; but inflammation of the periosteum never occasions decay of the tooth.

If inflammation were the exciting cause of caries in the teeth, decay in these organs being of so very common occurrence, daily, nay, hourly applications would be made for relief by individuals suffering under this incipient stage of the disease.

On the contrary, we scarcely meet with one case in ten thousand that Mr. Bell could claim as being at all applicable to the support of his theory. Moreover, this doctrine has a very dangerous tendency, particularly coming from so high an authority,* and it is principally on this account that I notice this error, and that I have introduced this gentleman's

* Mr. Bell is known to be a gentleman of high literary attainment; Lecturer on the Anatomy and Diseases of the Teeth, at Guy's Hospital, and Surgeon Dentist to that Institution.

name so often in this work; otherwise the public may be induced to believe that they will have timely notice of the commencement of decay from the inflammation and pain which Mr. Bell erroneously supposes to precede caries; and believing in this doctrine, they would naturally be led to conclude, that in the absence of pain their teeth must be in a sound state. This is a fatal mistake, and to this misconceived notion may be fairly attributed most of the mischief which befalls the teeth. I have done what I can to correct this erroneous impression. I have introduced the subject at the commencement of the work; in the body of the work I have pointed out the insidious character of caries and the evils which result from the want of a correct knowledge of its cause and progress; and at the end of the work I have reminded my readers of the mischief which results from neglecting their teeth until the commencement of pain.—I have also endeavoured to impress upon the minds of my patients the necessity of watchfulness; of occasionally looking into their mouths, and inspecting their teeth.—I have warned them not to depend upon feeling, or they certainly will be deceived, and that periodical visits ought to be made to the dentist, in order that he may have an opportunity of detecting decay in its first stages, before pain has been produced, and before the evil has become irremediable. This is the doctrine which I have for many years insisted upon, and I have now the satisfaction of saying, that my advice has been generally attended

to, particularly amongst the more intelligent and better class of my patients; consequently, an important change has been produced; for instead of waiting for pain as was formerly the case, and consulting me for relief when none could be given without extracting the diseased tooth, they are now in the habit of having their teeth inspected at stated periods for the purpose of preventing pain and doing away with the necessity of undergoing this disagreeable operation.

“A tooth which has been the subject of inflammation (says Mr. Bell,) will often remain without any diseased appearance for weeks or months afterwards; but at length the consequences which I have described become obvious, by the occurrence of a darkened spot which shows itself through the enamel; and the gradual destruction of the tooth follows, if means be not taken to arrest its progress.”* I have never met with a case of this kind, and if such cases were of so common occurrence as Mr. Bell supposes, I cannot believe that they could possibly have escaped my observation, for few have had more ample opportunities of ascertaining the fact.

Mr. Bell, upon laying down his theory, remarks, “Unless this opinion be correct, my ideas on the diseases of these organs are wholly fallacious, and the mode of practice which I shall have to recommend, founded altogether upon false data.” I cannot help thinking that Mr. Bell’s theory must have been formed in his younger days, and before he had ac-

* Bell, page 124.

quired the practical knowledge which I believe him now to possess. I must suppose this to be the case, for I cannot think that it is possible that such views can be entertained by an experienced practitioner; nor can I believe that the numerous facts which so constantly and so forcibly present themselves to the every day operator, in opposition to Mr. Bell's notions, can possibly be mistaken or overlooked.

And what is the mode of practice recommended by Mr. Bell? It is suggested by his theory, and naturally arises out of it. "In the earliest stages of gangrene, (says he,) at which its existence can be ascertained, when its only indication consists of an opaque or darkish spot upon the enamel, and before the subjacent bone has become softened, the careful removal of the diseased spot should, if practicable, be immediately effected."*

In most cases the treatment here recommended is premature, and in not a few it is altogether unnecessary.—For instance, in such cases as I have before alluded to, when decay takes place on the contiguous sides of two teeth, particularly on the bicuspidæ, when they come in contact with each other at their lateral edges, and diverge towards the gums, so as to adapt themselves for intercepting food in that situation. The side of one of these teeth is often more liable to be acted upon than the side of the other tooth, in consequence of having a neck or depression calculated to retain a greater portion of

* Bell, page 139.

decomposed food; it will therefore proceed with greater rapidity to that stage of decay, in which the membrane becomes exposed and inflamed, so as to render its removal necessary, before the other tooth has received much injury. At this period it will be perceived, that the side of the remaining tooth has only become blackened; and now that its neighbour is removed, and no resting place left to harbour the putrid substance, decay proceeds no further, and the blackened portion of the enamel continues the same during the life of the individual, without undergoing the slightest change.

Now these are cases which constantly occur which every dentist ought to be acquainted with, and which thousands of individuals, who have lost one or more of the teeth above mentioned, may observe, by examining the lateral edge of the tooth adjoining the one lost.

In such cases as these, there is no necessity for operating upon the tooth; there is a black spot it is true upon the side of the tooth, from the effects of chemical action, but it is upon the surface of the enamel; not upon the surface of the bone within the enamel; and as no cavity has been produced, no lodgment will take place, consequently the chemical action will proceed no further. If the patient should be desirous of getting rid of this dark spot for the sake of appearance, it may be removed with the file without penetrating through the whole thickness of the enamel.

The dentist who upholds the theory of decay first commencing upon the surface of the bone within the enamel, must often be induced to perform premature, and sometimes unnecessary operations upon the teeth; that is to say, if his theory and practice agree. When he perceives a darkish spot on the enamel, his object will naturally be to penetrate through the whole thickness of the enamel to get at the root of the evil, because he erroneously believes the darkened spot to be upon the surface of the bone, and that it “shews itself through the enamel.”

It is generally after a decayed tooth has been removed, that the dark spot here alluded to is observed upon the lateral edge of the adjoining tooth. Instead of proceeding thoughtlessly and hastily to the removal of this dark spot with the “file and strong steel brooches,” I should recommend the discoloured part to be minutely examined with a probe, and if the enamel should be found to present a smooth, hard surface, and no cavity produced, it would be injudicious to perform any operation upon the tooth, for now that the exciting cause is removed, by the extraction of the adjoining tooth, the food will no longer be retained, and the chemical action ceases. But if discolouration is observed upon the lateral edges of two teeth, to preserve both, it becomes necessary to make a separation between them, for the purpose of getting rid of the obstruction, and allowing the food to be removed; or, if it should be found

after the separation has been made that decay has penetrated the side of either of the teeth, the cavity must be filled up so as to prevent a further lodgment.

From the want of a correct knowledge of the character of caries and its exciting cause, Mr. Fox has been led into error, both as to the time when a tooth ought to be filled, and the manner in which the operation ought to be performed. The mode of treatment which he recommends in filling the front teeth of the upper jaw, is so very objectionable, and so pregnant with mischief, that I hope it will never be attempted by any one. "The incisores of the upper jaw," says Mr. Fox, "although very liable to become carious, do not often occasion the tooth-ache; but when this is the case, I always recommend the extraction of the tooth before any inflammation has affected the gum; the decayed part of the tooth may then be removed, or the cavity be very perfectly stopped with gold leaf, and it is then to be returned into the socket. The fangs of these teeth being straight and concave, renders this operation almost always successful; the tooth soon becomes perfectly fixed and may remain many years useful for the articulation of sounds, as well as ornamental to the sight."*

I am not afraid of any intelligent and experienced dentist adopting the plan here recommended; but we have so many in the profession of a different

* Fox, Part II, page 41.

class, void of the qualifications above mentioned, that I think it right to notice this most objectionable mode of practice, in order that it may be avoided by even those who are not in the habit of thinking for themselves, and who might be likely to follow the example of so high an authority as Mr. Fox.

Again, Mr. Fox is in error as to the time when the tooth ought to be filled up. "More commonly, at first," says he, "the pain of toothache is slight, and occurs at intervals, being occasioned by exposure to cold, or the accidental pressure of some adventitious substance, such as a piece of crust, the seed of some fruit, or any thing sweet; either of these getting into a tooth, partially decayed, generally causes some uneasiness. This kind of pain may almost always be relieved by a little *tinctoria opii*, or it may subside of itself; in either case, a recurrence may generally be prevented by filling up the cavity of the tooth, with some substance sufficiently hard and durable to keep out particles of food, and not liable to be acted upon by the moisture of the mouth."*

At page 26, he remarks, that "generally no toothache is experienced until the caries has made some progress." This observation of Mr. Fox is perfectly correct; but by the way, it is in direct opposition to his theory, "that inflammation is the exciting cause of caries; for as I have before observed, if inflammation were the exciting cause of decay, we should

* Fox, Part II. page 27.

have the pain attending this inflammation previously to the commencement of decay.

The period for filling a tooth is at that stage of decay when no pain has been produced; not when it has advanced so far as to expose the nerve, when the "accidental pressure of some adventitious substance, such as a piece of crust, or the seed of some fruit," will occasion pain; when it arrives at this stage it is too late. I cannot understand how Mr. Fox, with his experience, could have overlooked this fact; and I am equally at a loss to conceive, how he possibly could "fill up the cavity of the tooth with some substance sufficiently hard and durable," and at the same time prevent this *hard substance* from pressing upon the nerve, and producing the same effect occasioned by the piece of crust.

It is generally supposed that the teeth continue to grow after they have appeared above the gums. Accordingly when a front tooth is much disfigured by a portion being accidentally broken off, (which is not unfrequently the case,) instead of removing the useless and unseemly looking tooth, and allowing the adjoining ones to approximate and fill up the vacancy, it is allowed to remain from a false impression that nature will again restore the defective part. If only a small portion has been broken off, and the cavity within has not been exposed, the appearance of the tooth may be improved by smoothing the broken surface with a file; and the tooth may be as durable as the adjoining one, but the portion

broken off can never be restored. If the enamel be defective in its formation, the front teeth may often be improved by filing a portion of their cutting edges; but nature does nothing for the teeth after they have appeared above the gum; it has finished its work, and the parts once formed undergo no after-change.

When it becomes necessary to remove a tooth in early life, there is always a tendency in the adjoining ones to approximate, and fill up the vacancy. This is particularly the case where the teeth are crowded; and the circumstances of the vacancy being filled up in this way, has no doubt led to the supposition that the teeth increase in size after they have appeared above the gums.

The destruction of the teeth is very commonly attributed to some change in the constitution, brought about by bodily indisposition; and we often hear it remarked by our patients, that previously to being attacked by some severe illness, their teeth were perfectly sound and free from pain; but that immediately after this attack, they observed that several of their teeth began to decay; and they felt convinced that the mischief was occasioned by some unfavourable change which had taken place in their constitution. Upon examining a case of this description, I have found, perhaps two teeth out of the thirty-two in that stage of decay in which the nerve becomes exposed, and pain is produced; I have observed two of the others approaching towards that stage, and the remaining twenty-eight in a healthy state and

free from decay. I do not bring this forward as a rare case ; it is one of constant occurrence. I would therefore ask, how does it happen that the severe illness or constitutional change mentioned should have had so decided an effect upon only two of the teeth, that it should have had so partial an effect upon the other two, and that it should have had no effect at all upon the remaining twenty-eight ? If decay of the teeth were occasioned by a change in the constitution, we should naturally expect that all the teeth would be acted upon, because they all depend upon the same constitution. I have before remarked that the durability of the teeth depends upon a healthy state of the constitution during the period when they are being formed, but that when once formed they are affected by no constitutional change, and are influenced only by chemical action.

In the case which I have been describing, and indeed in all cases where decay of the teeth has been supposed to be the result of bodily indisposition, if the teeth had been examined previously to the illness of the patient, those to which I have alluded would have then been found in a carious state ; but at that period they were not suspected, because decay had not arrived at the stage when pain is produced ; decay having, however, arrived at this stage shortly after the person had been indisposed, the destruction of the teeth is erroneously attributed to this temporary debility of the constitution. A better reason than this can be adduced why

the teeth become carious at different periods of life.

When the teeth have appeared above the gums, the dentist, if he has made the subject under discussion his study, will not only have no difficulty in pointing out to his patient the teeth which are predisposed to caries, but he will be almost able to foretell the time when their destruction will be effected; for upon examining their structure and position, he will at once see the surfaces of particular teeth presenting through the whole thickness of their enamel, fissures so deep and so well calculated to retain decomposed matter, as to leave no doubt that in such situations the chemical action will be rapid, and the destruction of the teeth effected, perhaps, in twelve months after their first appearance.

Again.—In some of the neighbouring teeth, fissures will be observed, but not so well calculated for retaining extraneous matter as those before mentioned; consequently, the chemical action on them will be less rapid, and it will require more time to accomplish their final destruction. A tooth may be destroyed by caries in one year after it has appeared above the gums; in other instances it may be ten, twenty, and even forty years, before caries has proceeded so far as to lay open the internal membrane, and produce toothache.

Parents often express surprise that the teeth of their children should be lost by caries at an early age, and particularly when their children are in the enjoyment of health. After the teeth have been

formed, their destiny is fixed, and the slow or the rapid progress of decay will depend upon the adaptation of the part in the tooth to retain more or less of decomposed matter; much will also depend upon the attention which is given to the cleaning of the teeth; for although it is not possible to dislodge with the brush the whole of the matter from a deeply formed cavity, nevertheless, by this means, a portion of it may be removed, and the chemical action will proceed with less rapidity.

Decay of the teeth does not then arise from bodily indisposition; the teeth are only acted upon chemically, and the period of life when their final destruction takes place, that is, when the nerves become exposed, depends upon their structure and position. Decay never commences upon the plain surface of a tooth. There must be a receptacle for the food to lodge in; here the tooth becomes decomposed, and here the chemical action begins; the progress of which upon the surrounding parts, will be in proportion to the capability of the fissure for retaining more or less of the destructive matter.

During the process of mastication, it frequently happens that a portion suddenly breaks off from a tooth which, previously to this occurrence, was supposed to have been perfectly sound, and free from decay. But the true cause of the breaking of the tooth is not generally understood. It is a mistaken notion to suppose that the teeth are of a brittle nature, and subject to accidents of this kind; and

it is equally erroneous to imagine, that the teeth in masticating the more solid kinds of our food such as crust, biscuit, etc., are liable to be broken. The teeth, in a sound state, are strong and compact in their structure, and well calculated for all the offices which they have to perform,—for cutting, breaking, and grinding, without sustaining the least injury, harder substances than the food upon which man, in a state of civilization and refinement, is in the habit of subsisting.

Upon examination it will be found that in almost every instance where a portion of a tooth has been broken off during mastication, it is in consequence of decay having previously made considerable progress on the lateral edge of the tooth. The double teeth are very liable to become carious in this situation; and as this part is often concealed from view by the juxta-position of the teeth, the mischief is not readily detected, without minute examination, until decay has penetrated the side of the tooth, and undermined its enamel. The enamel being thus deprived of its support, is easily broken down by the slightest pressure from the food during the process of mastication.

The only way to prevent an occurrence of this kind is to have the teeth regularly inspected at least once in twelve months; and in most cases decay may be detected, and permanently arrested, before injury is sustained.

It should always be remembered that the teeth

are differently constituted from the other parts of the body, and that they require different treatment. The bone and the enamel of the teeth are void of feeling; and as long as decay is confined to these parts, no pain is produced. It is altogether different with the other parts of the body; they are highly organized, and cannot be injured in the slightest degree without producing a painful sensation; and, consequently, the very commencement of disease may be detected. There is also in them the power of restoration; and, by proper treatment, they may be brought to a state of health. But in a tooth, decay may be going on for years without producing the slightest feeling or inconvenience; and it is only when a portion of the tooth breaks off, in the manner which I have described, or when decay has penetrated the enamel and bone, and excited inflammation, that the patient becomes aware of the mischief. It has then become too late for remedial measures, and to obtain relief the tooth must be extracted.

The eating of sweets is, by some individuals, supposed to occasion decay of the teeth; but this is also a mistaken notion. I am not aware that there is any kind of food that may be admitted with safety into the stomach, which is capable of injuring the teeth at the period when it is taken, or during the process of mastication; it is only that portion of the food which is retained in the fissures and interstices of the teeth that does the mischief; and this

is occasioned by the change which the food undergoes.

When the food has been retained in the fissures and cavities of the teeth, it undergoes a process of decomposition; it entirely changes its original nature, and acquires a property and a power similar to that of acids, capable of destroying the teeth, by disuniting the phosphate of lime and the animal matter of which they are composed. Possibly some kinds of food when in a state of decomposition may be more powerful than others, in effecting the destruction of the teeth; but all kinds of food, while undergoing this process, accomplish the destruction of the teeth sooner or later.

Mercurial medicine is supposed to occasion decay of the teeth; and when decay in these organs happens to arrive at its painful stage, shortly after the patient has undergone a course of mercurial treatment, the injury is sure to be attributed to the influence of the medicine. This is also a mistaken notion; and, upon examination, it will be found, even in the worst of cases, where the largest quantities of mercurial medicine have been taken into the system, and where the greatest mischief has been occasioned to the other bones, that the teeth have not been acted upon; their sockets may have been destroyed, but the teeth themselves will have sustained no injury.

I have before stated that the teeth are differently constituted from other bones; that their durability

depends upon a healthy state of the constitution at the period when they are being formed; but when once they have been formed, (and this takes place in early life,) they are not influenced by any after-change of the constitution.

During childhood, when the teeth are being formed, they are liable to injury, and of course permanent injury, from the constitution being under the influence of mercury; and that this frequently happens from the abuse of this medicine, from the careless and profuse manner in which it is sometimes administered to children, there cannot be the slightest doubt; but the constitution has not the power of effecting a change in the teeth after they have been formed.

If the enamel and bone of the teeth were organized bodies and subject to inflammatory action, as has been supposed, they would also be subject to mercurial action; but they are subject to neither. Mercury has no influence in producing caries of the teeth; it is true that it occasions their loss by the destruction of their sockets, but upon the teeth themselves it has no effect. The other bones may be affected; the softest, the most porous, those which are the most highly organized, are the first to suffer from mercury; and the sockets of the teeth, being of this class, are amongst the first to be affected; consequently, the teeth lose their support and drop out, or, perhaps a portion of the alveolar process exfoliates, with a number of teeth attached to it;

but, upon examination, it will be found that the teeth thrown off are in a sound state, unless affected by caries previously to the introduction of mercury into the system. The insertion of the same teeth, which have fallen out from the effects of mercury, is a circumstance of frequent occurrence, and one which must often have come under the notice of every dentist in any thing like extensive practice. I have very often had occasion to attach the same teeth to a gold plate, and to fix them again in the patient's mouth. I have also had an opportunity of watching their progress from year to year; but I have not been able to distinguish the slightest difference between them and other natural teeth fixed in a similar way.

The peculiarity of structure and constitution of the teeth have not been duly considered, and hence the many erroneous notions which have been advanced regarding the cause of their destruction, and the cure of their diseases. Were we to enumerate all the prejudices which are entertained, and the nostrums which are recommended, this work would be extended beyond its intended limits. Enough, perhaps, has been said to give the reader a correct knowledge of the cause of the destruction of the teeth, and of the means to be employed for their preservation. This is the sole object which I have in view in laying my opinions before the public; opinions which have been collected from twenty years' extensive practice and minute observation, and

which I feel persuaded will stand the test of experience, because I know them to be grounded upon facts.

The amount of suffering which arises from the want of a correct knowledge of the cause of the destruction of the teeth, and the means necessary for their preservation, is incalculable. The dentist is not the only individual who ought to be acquainted with this subject; it is also necessary that the patient should have some knowledge of it; otherwise the proper means for the preservation of the teeth will be neglected, until pain occurs, and the evil has become irremediable.

The system generally adopted with regard to the other parts of the body, is to wait until pain has occurred, and then to apply for medical advice; and by judicious treatment relief may be obtained, and a cure effected; because the parts with which the medical man has to deal are highly organized, and have the power of restoration. But it is not so with the teeth; in them there is no power of restoration; to preserve them disease must be prevented, or they are lost; they cannot be cured.

When the membrane of the tooth has been laid open by the destruction of a portion of the enamel and bone which surround it, the membrane continues exposed, the constitution has not the power of repairing the breach which caries has made into the tooth, and any attempt to stop up the hole by artificial means, would only irritate the already in-

flamed membrane and increase the evil. In order, therefore, to preserve the teeth, it is absolutely necessary that they should be watched by the patient, and regularly inspected, at least once a year by the dentist, for the purpose of preventing disease; and if this were more generally known and attended to, much suffering and inconvenience would be avoided.

CHAPTER VIII.

A FEW BRIEF HINTS ON THE GENERAL MANAGEMENT OF THE TEETH.

AT the time of birth the temporary set of teeth, twenty in number, are in a state of forwardness; and generally about the sixth or seventh month after birth, the central incisors of the lower jaw rise above the gums. The coming through of the whole of the first set occupies about two years, but sometimes a longer period is required. At the age of three the set is generally complete.

During this period of three years, the bodies of one half of the permanent set of teeth are also formed, namely the eight incisors, the four canine teeth, and the four anterior molar teeth. These teeth are very often defective in the formation of their enamel, and consequently very subject to caries; whereas, the sixteen teeth which are afterwards formed, and which complete the permanent set, are much more perfect in their formation. This may be readily accounted for, if we consider that the first sixteen teeth of the permanent set are formed at a period when the child is often suffering severely from the coming through of the temporary

set; but after the excitement so often occasioned by the coming of these teeth has ceased, the child's health begins to improve; and it is natural to expect that the teeth which are afterwards formed will be more perfect.

The durability of the teeth in after-life very much depends upon a healthy and vigorous state of the constitution during the period of their formation. It must be remembered that the teeth are not like the other parts of the body, influenced by every change which the constitution may undergo in after-life; they are only subject to it during the period of their formation, and when once they are formed they undergo no change.

The first consideration, then, in securing a perfect set of teeth, is to attend to the health of the child during the period when the teeth are being formed. It is not my intention to inquire into the character of the numerous ailments to which the child is subject during the first three years of infancy; nor shall I prescribe remedies for any of these complaints; this I shall leave to the physician and surgeon. But I cannot pass over this critical and dangerous state of a child's existence, without strongly impressing upon the minds of parents the great benefit which results from the frequent and free use of the lancet to the gums during the period of dentition. Upon this subject I perfectly agree with Mr. Fox and Mr. Bell; nor can I do better than quote the former in his own words: "Under

every circumstance of indisposition, arising from dentition, the lancing of the gums ought never to be omitted. The benefit which attends the operation is so sudden, and, if performed sufficiently early, is so certain, that it ought never to be neglected. As soon as the gum is lanced, and the membrane is divided, the tooth obtains an increase of room, the pressure is immediately taken off from the socket, and the cause of irritation is removed.

“It is very surprising that, notwithstanding the manifest advantage which attends the lancing of the gums, in cases of painful dentition, there are persons who entertain strange prejudices against this safe and important source of relief. But the uniform experience of its good effects, and no instance of its doing harm ever having occurred, should produce an unanimous consent for adopting it. Some persons object to the operation on account of the pain which it will occasion to the child, not considering that the inflammation produced by the resistance of the gum to the tooth, is far more acute than dividing the gum with a sharp instrument. Others suppose that the formation of the teeth is injured, and that they are more liable to decay; but neither of these circumstances can occur; for, at the time the tooth is about to pass through, the enamel is completely formed, and no injury can be done.

“When it is necessary to lance the gums, some time before the teeth are quite ready to appear,

they unite, and in this case the cicatrix has been said to impede the progress of the tooth, presenting a greater resistance than the gums in their natural state; but it is now certainly known that a newly formed part always gives way sooner to the process of absorption than the surrounding parts, and hence the passage of the tooth is facilitated.

“The hæmorrhage which is occasioned by the operation is never considerable, but is always beneficial; the vessels become unloaded, and the inflammation is always soon diminished.”

At three years of age, when the first set of teeth are completed, the tooth brush should be regularly used morning and evening; and by adopting this simple mode of treatment, children would be exempted from much of the suffering which is so frequently experienced from caries in these teeth. But it is also of importance that the first set of teeth should be preserved until their successors are ready to make their appearance. When, in consequence of pain it becomes necessary to remove these, and particularly the posterior double tooth, at an early period of life, the first molar teeth of the permanent set, which are stationed beyond the range of the temporary set, approach towards the front of the mouth, and encroach upon the space allotted for the permanent teeth, thus occasioning great irregularity in their arrangement.

To preserve the temporary teeth from decay, treatment similar to that which has been recommended

for the preservation of the permanent teeth should be adopted. They must be kept clean, and regularly inspected, for the purpose of detecting and arresting decay in its first stages, before pain has been produced. If this be neglected until the occurrence of pain, which is generally the case,—for at this early age parents seldom attend to the teeth of their children in the absence of pain,—it then becomes necessary to remove the diseased tooth, not only on account of the constant annoyance and suffering which the retaining of it must occasion, but because of the injury which the permanent teeth are liable to sustain from the irritation thus produced, and from the inflammation extending to the neighbouring parts.

We now come to that period of the child's life when the teeth require the greatest attention, when the first set begin to loosen and fall out to make room for others more numerous, possessing increased powers of mastication, and a durability of structure calculated to endure, with proper management, to the latest period of life.

The four anterior molar teeth are the first which appear of the permanent set. They come when the child is about six years of age, and generally a few months before the temporary set begin to loosen and drop out. These teeth take their station immediately beyond the temporary set, at the extreme ends of the jaws, which by this time have elongated sufficiently to contain them; and being situated at

the back of the mouth, they are either mistaken for temporary teeth, or they escape notice altogether, until it becomes necessary to remove them in consequence of pain. They are exceedingly liable to decay; so much so, that they frequently require to be extracted the first or second year after they have made their appearance.

The removal of these teeth is a very sharp operation for a child, at this early age, to undergo; for it must be remembered, that even at this period of life, these teeth have attained their full size.

When it becomes necessary to remove the first teeth to make room for the second set, the amount of pain experienced is but trifling, because the fangs of the temporary teeth have become partly absorbed, and they are not firmly attached to their sockets; but when the four permanent teeth require to be extracted, which is frequently the case, I cannot help feeling a degree of sympathy for the child who is necessitated to undergo this operation. To retain these teeth in a state of disease, in order to save the child the pain attending the removal of them, would be very injudicious; for the prolonged misery which the child would suffer by the adoption of this plan, would far exceed the pain of undergoing the operation. Moreover, to insure the comfort and usefulness of the teeth which have yet to appear, it becomes absolutely necessary that the diseased ones should be removed. To preserve these teeth, then, and to save the child from suffering, they ought to be mi-

nutely examined upon their first appearance; and there can be no difficulty in ascertaining whether they are, or are not, liable to caries; for if their grinding surfaces present deep fissures in the enamel, we know that in these parts the food will lodge, and decay will be the result. Teeth of this description must be watched, and filled up before decay has proceeded so far as to produce pain; for if they be neglected until the occurrence of pain, filling them instead of being of service, will only irritate the exposed membrane, and increase the suffering.

Having noticed the first four teeth of the permanent set, and pointed out the treatment necessary for their preservation, I now direct the attention of the reader to the twenty new teeth which are about to take possession of the space at present occupied by the same number of old ones.

When the child is between six and seven years of age, the front incisores of the lower jaw generally present themselves; after them, the front incisores of the upper jaw; these are followed by the lateral incisores, first of the lower, and then of the upper jaw. The bicuspidæ come next, and the cuspidati commonly make their appearance the last.

The coming through of the teeth generally occupies four or five years; and during that time the greatest watchfulness is necessary, and the assistance of the dentist is often required, to preserve the symmetry of the mouth, and to prevent that de-

formity in the appearance of the face which a crowded and projecting set of teeth so frequently occasions. In almost every instance, at this period of life, the arrangement of the teeth is under the control of the dentist; and by timely and judicious management on his part, they may be placed in regular order. The projecting chin occasioned by the upper incisors shutting within the lower ones, instead of over them;—the protuberance of the lips in consequence of the canine teeth standing out of the circle;—the contraction of the jaw and rabbit-like appearance of the mouth;—the oblique and cross position of the incisors, often placed with their lateral edges towards the front of the mouth;—these and other forms of irregularity in the arrangement of the teeth of young persons may, in a large majority of instances, be fairly attributed either to ignorance or neglect on the part of the parents.

The plainest countenance is very much improved by a well arranged set of teeth, and on this account it is desirable; but there is another consideration of greater importance, namely, the durability of the teeth. A crowded set of teeth is extremely liable to become carious. From their zigzag position, and from the one tooth standing behind the other, it is impossible to keep them clean; tartar will accumulate; food will lodge in the interstices and receptacles produced by this irregularity, where it is impossible to remove it with the brush; consequently decay takes place, and the destruction of the teeth in early life will be the result.

From the age of eight to twelve it often becomes necessary to remove several of the permanent sound teeth to make room for the others; the anterior bicuspidés are generally the teeth which ought to be removed, and for reasons which have already been given. But when the regulating of the teeth has been neglected until a later period, the incisores, particularly of the lower jaw, are found so crowded as to require the removal of one or more of them, and occasionally the lateral incisores of the upper jaw, when they come so as to shut within the lower teeth. The loss of these teeth spoils the symmetry of the mouth, and this might be avoided by the extraction of the anterior bicuspidés, as above recommended, at an earlier period.

There are some parents who object to this mode of practice; they think it a pity for a child to part with a good sound tooth, for, say they, so liable are the teeth to decay, they will be obliged to loose them soon enough. Such parents ought to be informed that a crowded state of the teeth is one of the principal causes of decay, and when caries attacks the lateral edge of a tooth as it always does in this case, two teeth are generally lost instead of one; and moreover, decay in this situation is seldom perceived, particularly in the double teeth, before it has proceeded too far for remedy, and even when it is detected at an early stage, the situation is so difficult to get to with the file, or the filling instruments, as often to render either operation unsuccessful.

I consider it of the greatest importance that the teeth should have plenty of room; and it would be well if there were a small space between each tooth, so as to admit of the brush reaching every part that is above the surface of the gums. When we find the teeth thus arranged, we seldom meet with decay at their lateral edges.

At the early age of from eight to twelve, the four anterior molar teeth of the permanent set are often very much decayed, and when this is the case it is better to remove them to make room for the others, than to attempt to save them, unless they can be permanently saved by filling, which can only be done at an early stage of decay. The pain attending the extraction of these teeth is the only consideration, for the vacancies occasioned by their loss will soon be filled up by the approximation of the adjoining teeth, and their loss I have observed to be an advantage rather than a disadvantage, because more space is given to the remaining teeth, and more to the wisdom teeth that have yet to appear, which are generally lost for want of room.

In a well regulated set of teeth, the six front teeth in the upper jaw shut over the six lower ones, and the pressure in mastication is thrown principally upon the double teeth, which from their form and strength, are well calculated for grinding the food. But the front teeth are not adapted for this purpose; they have thin sharp edges, and their office is to cut the food. It sometimes happens, however, when

their arrangement is left to nature, that they are converted into grinding teeth. The position which they take is such, that in shutting the mouth the cutting edges of the upper and lower incisors come in contact with each other, and are soon worn down by friction during the process of mastication, so much so as to assume the appearance of double teeth. But the appearance is not the only consideration; they soon become destroyed. The grinding down of the crown of the tooth lays open the internal cavity, and produces inflammation of the membrane there contained.

At eleven years of age, in most instances, the whole of the temporary teeth are gone, and their places supplied with permanent teeth. At this period the jaws contain twenty-four teeth; and the remaining eight, which have yet to appear to complete the set, are the second molares, and the *dentes sapientiæ*. The former of these generally come about the twelfth year; but the coming of the latter is very uncertain. They sometimes appear before the eighteenth year; occasionally they are ten or twelve years longer in coming; and in many instances they do not come at all. The coming of these eight teeth should be watched, and their surfaces minutely inspected, upon their first appearance; and there will be no difficulty in ascertaining whether they are, or are not liable to decay. It will often be found necessary to fill these teeth soon after they have appeared, for reasons which I have given in another part of this work. (See pages 20, 21, and 22.)

The coming through of the wisdom teeth is often attended with considerable pain, and it is in consequence of there not being sufficient room in the jaw-bone to contain them. After they have partly appeared it is sometimes years before the whole of the grinding surfaces of these teeth rise above the gums; and, during this period, that portion of the gum which partly covers the tooth becomes inflamed, so much so, as often to occasion very acute pain. In such cases the best remedy is to remove the overlapping gum with a lancet.

I have before stated, that between the age of six and twelve years the teeth require the most attention; because, during this period, it is necessary to attend to their arrangement, as well as to detect and arrest caries in time; and moreover, during this early stage of life, there is the greatest tendency in the teeth to decay. (See pages 37 and 38.) From the commencement of the shedding of the first teeth, and until their places have been supplied with second teeth, I have generally found that they require to be inspected at least twice in the year; but afterwards, if proper attention be given to the cleaning of them, once in twelve months, in most cases, will be sufficient; and if this plan were more generally adopted, there would be but little necessity for extracting teeth.

There are some persons whose teeth are altogether exempted from caries, and require no assistance from the dentist. But it will be found, in cases of this

kind, that the teeth are regular in their arrangement, and that the sections of the enamel upon their surfaces are closely united; therefore, they do not present receptacles for the food to lodge in, and, consequently, there is no tendency in such teeth to decay. There are, however, but few cases of this description; and to prevent the teeth from being destroyed by caries, much attention is required.

There is great difficulty in impressing upon the minds of individuals the necessity for this attention; and this arises from the circumstance of decay commencing and proceeding, in the absence of pain, to that stage when remedial measures are no longer available, and when it becomes necessary to extract the tooth. It is very natural to suppose, that the teeth are in a sound state as long as they are free from pain; and, in consequence of such an opinion, to withhold attention from them until they become troublesome. (See pages 47, 48, and 49.)

There are, indeed, but few who give that attention to the teeth which is necessary for their preservation, before they have experienced considerable suffering, and the loss of several teeth; but when this has occurred, we generally find that proper attention is given, and means employed for preserving the teeth which remain.

The art of preserving the teeth is to keep them clean; and, if this can be accomplished, there will be no tendency in them to decay. The teeth of some persons being regular in their arrangement, and

their enamel closely united, as shown in Plate II., fig. 3, 4, are capable of being kept clean by the proper and daily application of the tooth brush; but in a large majority of cases, the form of the teeth is like unto those which are represented in the same Plate, fig. 1, 2, with fissures extending throughout the whole thickness of the enamel; and from the bottom of these deep pits it is impossible, by means of the tooth-brush, to remove the particles of food that will lodge. In such cases, the assistance of the dentist becomes necessary, and his art consists in remedying this defect in the structure of the enamel, by filling up these receptacles for the food, and thus enabling the patient to keep his teeth clean by the application of the tooth-brush. Upon the same principle, the dentist assists the patient to keep his teeth clean, by passing a file between them, and thus removing resting places for the food, which are formed in the interstices of the teeth, by the irregularity of their shape and juxtaposition. (See Plate III., fig. 2, 4, 5.)

It would be well if persons would look into their mouths, and make themselves familiar with the form and arrangement of their teeth, in order that they might ascertain the practicability or impracticability of keeping them clean by means of the tooth brush. At all events, a knowledge of the structure and position of their teeth would enable them to apply the brush in a way the best calculated to effect this purpose; for there is even in the right per-

formance of this simple operation, some little art required. The attention should be particularly directed to the grinding surfaces of the double teeth; these are the most subject to decay because of the irregularity of their structure, and consequently, of their tendency to retain food. A brush, consisting of rather hard and elastic bristles, should be applied firmly across the masticating surfaces of these teeth, for the purpose of removing the remains of food, before decomposition takes place, and before chemical action has commenced.

The lateral edges of the teeth also require to be particularly noticed; for here the food is extremely liable to lodge, and more particularly, if the teeth be crowded and irregular in their arrangement. The most effectual way of removing the food from the interstices of the teeth, is to brush them upwards and downwards, and not across as is generally done. The brush to be used for this purpose does not require to be so hard as the one which I have recommended for the grinding surfaces of the double teeth; but it ought to contain bristles sufficiently firm and elastic to penetrate between the teeth.

By adopting this mode of brushing, there is no danger, as some people imagine, of removing the gums from the necks of the teeth; on the contrary, it is the most effectual method, if the gums be loose and spongy, and subject to bleed, of restoring them to a healthy state, and of causing them to adhere firmly to the necks of the teeth.

If it were possible to impress upon the minds of people the necessity of early and constant attention to the cleaning of their teeth, and if they would but adopt the plan of having them regularly inspected, for the purpose of detecting decay in its first stages, and before pain was produced, much misery and acute suffering might be prevented. But from the ignorance and deep rooted prejudices which prevail regarding the teeth,—from the erroneous notions which are entertained as to the cause and nature of their diseases, judging of the teeth as they do of the other parts of the body, and neglecting them until the commencement of pain,—and from the great difficulty which there is in persuading persons to avoid an evil which they have not experienced, there are but few who will give that attention which is necessary for the preservation of the teeth, until it is forced upon them by acute suffering. If the teeth were like the other organs of the body, sensible to pain at the commencement of injury, and like these parts capable of being restored again to a healthy state, timely intimation would be thus given, and remedial measures might be adopted. But it is not so with the teeth; the enamel and bone of these organs are insensible to feeling; and as long as decay is confined to these parts, the individual is not aware of the mischief that is going on; it is only after decay has penetrated through both these substances, and laid open the internal membrane of the tooth, that the evil is

detected. Application is then made for relief when it is too late. It would be folly to attempt the filling up of a tooth at this stage. I speak from experience; I have often, very often, tried the experiment, and I have found that it has scarcely ever succeeded. In order, then, to preserve the teeth, they ought to be properly cleaned morning and evening, and regularly inspected at least once in twelve months, for the purpose of detecting decay in its first stages, and putting a stop to it before pain has been produced.

In conclusion, I would observe, that if the pathology of the teeth were more intimately known, and more minutely investigated by the medical profession generally, a considerable amount of benefit would thereby be conferred upon the public. To medical students especially would I direct this advice. Practising hereafter the healing art in all its branches, and perhaps in country districts, remote from a dentist, for the latter is generally to be found only in large towns, it is eminently desirable that they should be sufficiently acquainted with diseases of the teeth, to be able at once to distinguish between pain arising from these organs and pain proceeding from other causes. For the want of this knowledge on the part of the general practitioner, a patient is often doomed to undergo a course of tedious and ineffective treatment; to the endurance of much misery that might have been saved.

The teeth, unlike the internal organs of the body are not difficult of examination; they are easily scrutinized, and by a practised eye their defects are readily detected. As I have before observed, a tooth which occasions pain, whether the exciting cause be the exposure of its internal membrane from decay, or inflammation of the periosteum in the absence of decay, there will always be certain signs that will guide and justify us in our decision. And yet it often happens that when the teeth alone are the cause of much acute suffering, the mischief is overlooked, and the pain arising from them attributed to tic-doloureux, to rheumatism, to cold in the face, to ear-ache, or to some equally innocent and unlikely cause.

In all painful affections of the face, the teeth ought especially to be examined; they will generally be found to be the source of the mischief, and in the numerous supposed cases of tic-douloureux it will be found that the ailment is none other than acute toothache. In ear-ache also, the affection is frequently confounded with, or dependent upon a diseased molar tooth in the lower jaw. The same may be said of rheumatism and cold in the face when the pain is less acute. This dull throbbing pain commonly arises from the fangs of a tooth after the portion above the gums has been destroyed by caries, and the difference of pain as contrasted with acute toothache, depends upon the fact that in the former case the *periosteum* only is inflamed, whilst

in the latter the *internal membrane* is exposed and inflamed. In a former part of the work I have explained the cause of this acute pain occasioned by inflammation of the membrane within the tooth.

These remarks have suggested themselves in consequence of so many cases of acute suffering having occurred to my notice which might have been early remedied had the source of the mischief been distinctly understood.

It is true that the study of the pathology of the teeth and the treatment of their diseases have become the exclusive profession of a distinct class of medical men, to whom of course belongs a greater amount of practical opportunity, and from whom a more specific service is expected than from the general practitioner. Nevertheless it must be conceded that it is eminently the duty of every professor of the healing art to couple with his other acquirements a sufficient knowledge of dental surgery to enable him to form a correct diagnosis of local disease, though he may ultimately refer his patient to another source for a remedy.

The following cases are appended with the object of illustrating several familiar varieties of affections of the teeth, sufficiently frequent in their occurrence, but often either entirely overlooked, or mistaken for other ailments to which they bear no relationship.

CASE I. Mrs. L——, who had been suffering under supposed *tic-douloureux*, upwards of six months, and during that time had been unavailingly

treated with carbonate of iron and other tonics, consulted Dr. Evans of this town. After a careful and minute inquiry into her case, Dr. Evans suspecting her pains to arise from carious teeth, referred her to me. Upon examination I discovered that there were no less than four molar teeth so advanced in decay that the irritation of their exposed membranes readily accounted for the torture she had been enduring. Each of these teeth was so extensively carious, that I unhesitatingly expressed a belief that no permanent benefit could be anticipated unless the whole of them were extracted. She had suffered so much during the previous six months, that the operation appeared too formidable for her to accede to. Nevertheless she continued to endure an agonizing torture, and at the suggestion of her medical adviser and friends, resolved upon trying change of air. She went to Leamington, but her malady not subsiding, she consulted Dr. Jephson, who, after hearing her own detail of her case, and the opinions of her previous advisers, confirmed their decision that, before the institution of any other treatment the carious teeth should be extracted. This concurrence of testimony prevailed with her; her diseased teeth were removed at stated periods, and in a fortnight her health was so completely restored that she returned to her family perfectly free from pain and inconvenience. Two years have since elapsed, during which time she has had no return of her previous ailment.

This is one of the many cases which every day's experience brings before the notice of the practical dentist. I have introduced it not on the score of singularity, but as a type of the various species to which it belongs. Here it will be perceived, no less than four teeth were so diseased that their internal membranes were completely exposed from a destruction of the grinding surfaces of the organs. A diagnosis in such case could not be difficult. But in other instances caries may occur at the lateral edges of the molar teeth where they are in conjunction. In these cases the mischief is not so readily apparent,—a superficial examination will never detect it, as the following example proves.

CASE II. In 1835, I was consulted by the late Lord Lyttelton, who had for some time been suffering violent paroxysms of pain in the face. His lordship had formerly been my patient, but during this attack was residing in London, where he consulted a dentist, who, referring the pain to some teeth which had been previously stopped, removed their artificial contents and refilled them. No benefit however resulted, and his lordship on his return home consulted me. I observed that the pain was principally confined to the left side of his face. His lordship had an excellent set of teeth, and though several of them had been stopped by my friend, the late Mr. Thompson of London, yet the operation had been so early and so excellently performed, that I was quite certain the teeth

so treated were not the cause of suffering. Further, he informed me that the filling had remained in those teeth safely and without inconvenience, for upwards of thirty years. My attention was now directed to the lateral edges of the molar teeth, which I proceeded to examine by passing a bent probe round each tooth. After a careful search, the probe entered a cavity in the lateral edge of the second molar tooth in the lower jaw. My patient instantly exclaimed "there's the source of the pain." The remedy of course was evident,—the tooth was immediately extracted, and all suffering ceased. In a few days I received the following intimation from his lordship.—"Lord Lyttelton has no longer any pain in his teeth, and is much obliged to Mr. Robertson both for what he took and what he left."

Cases of this kind are commonly mistaken for *tic-douloureux*, from the resemblance which the pain bears to that of the latter ailment, and from the difficulty of detecting the source of mischief. Many such have occurred to my notice, but the one just recorded will be sufficient for illustration. I would advise in all cases of this kind, that before forming any decided opinion, or determining upon any particular mode of treatment, the teeth be carefully examined after the fashion I have described, and generally then, will they be found to be the offending cause.

I have already alluded (page 135) to the mischief arising from the retention of diseased molar

teeth in the lower jaw; to impress this fact more forcibly upon the mind of the general reader, I may subjoin the following case which occurred to my friend, Dr. Eccles, to whom I am indebted for its report. This case possesses certain points of interest which entitle it to a separate detail, though instances of a similar but less striking nature are familiar to the experience of every practical dentist.

CASE III. "Mr. C——, of Enville, in Worcestershire applied to me for my advice under the following circumstances. He complained of having suffered from pains of the head of various characters, —sometimes lancinating, sometimes obtuse; at times temporary and even evanescent, but acute; at others continuous and distressing and disabling him from pursuing his occupations; sometimes, and indeed most generally, local, being limited to one or both temples extending to the forehead or vertex, and sometimes situated over one or other of the frontal sinusses. He also complained of pain and a sense of rigidity down the sides of the neck. He had suffered in this way for more than twelve months before he consulted me, and during that time had consulted many medical practitioners, without receiving any benefit, his complaints having increased and become more severe and frequent. Together with the symptoms described, his general health had become greatly impaired, his strength having declined so as to disqualify him for any except the lightest and that only occasional bodily exertion, his

appetite having failed and his powers of digestion became feeble and disordered, his spirits in the highest degree depressed and desponding from an increasing apprehension of some incurable affection of the stomach or liver, or an approaching disorder of his mind. After having treated him for a considerable space of time at various intervals for the obvious derangement of the digestive functions and the impairment of his general health, with some, but by no means complete or satisfactory relief to his symptoms, he accidentally, and in a very indifferent manner, on one of his visits to me, adverted to a slight discharge which had recently taken place in one side of his throat, beneath the angle of the lower jaw, which on examination appeared to proceed from an aperture similar to the fistulous opening of a scrofulous abscess in the neck. Being led by the situation of the ulcer and the pains he had complained of in the head and down the side of the throat, to examine the state of the teeth which I found to be deeply decayed, and to inquire whether he had suffered much from tooth ache, I found he had been a great sufferer in the early part of his illness, and also that he had had for a length of time, a discharge from the part specified, which had however entirely ceased for many months. Believing that this might be the cause of most, if not all his sufferings, I recommended the immediate removal of the teeth which were decayed, and for this purpose accompanied him to my friend Mr.

Robertson, who concurring in my opinion, extracted them, and that with the effect of entire relief, and a speedy restoration to a perfect recovery of his health."

Abscesses which implicate the surrounding integument and burst externally, are less frequent in the upper than the lower jaw. This depends, no doubt, upon the readiness with which the matter descends and escapes by its own natural gravity. There are, however, instances in which fistulous openings in the upper jaw have been produced by carious teeth. The following is a case of a peculiar kind which occurred to my notice some years since:—

CASE IV. John Smith, aged fifty, had suffered for five years from a fistulous opening at the junction of the malar with the superior maxillary bone, on the left side of the face. He had during that period been submitted to extensive medical and surgical treatment, but without avail. Upon examination, I observed that the gums, immediately below the orifice, were tumid and unhealthy-looking. There were the remains of the fangs of the anterior molar tooth, which I removed. I suspected that there might be some exfoliation of the alveolar process, and upon examination with the probe, it came into contact with a substance, the surface of which, was much harder than that of bone. After having arrested the hemorrhage with lint, I perceived, high up in the cavity, a substance covered with enamel. With much difficulty I succeeded in removing it, and found

it to be a moderate sized molar tooth, complete in all its parts. According to my request, my patient called upon me in the course of a month, when I found that the fistulous opening had effectually healed, leaving a puckered cicatrix. I saw him many times subsequently, and had the satisfaction to learn that the parts continued in a perfectly healthy state.

Cases of this kind and termination are not of common occurrence; but, in the instances of new teeth appearing in the latter periods of life, it is far from improbable that the teeth, instead of being newly formed, had been for many years hidden in the jaw, and at last developed by the removal of the tooth which had previously obstructed their progress. In the present case, had the tooth, the fangs of which I had occasion to remove, been extracted earlier, and suppuration thereby prevented, the retained tooth might have descended and occupied the position of its predecessor. In this way the circumstance of teeth being cut in old age, may perhaps be accounted for.

From a contracted state of the jaw, as compared with the size of the teeth, the developement of the *dentes sapientiæ* is often a source of much uneasiness and pain. This is especially the case in the lower jaw. Much suffering is often consequent upon it, but relief may generally be obtained by a free use of the lancet, so as to remove the overlapping gum. In some instances this treatment fails, and it becomes necessary, when practicable, to re-

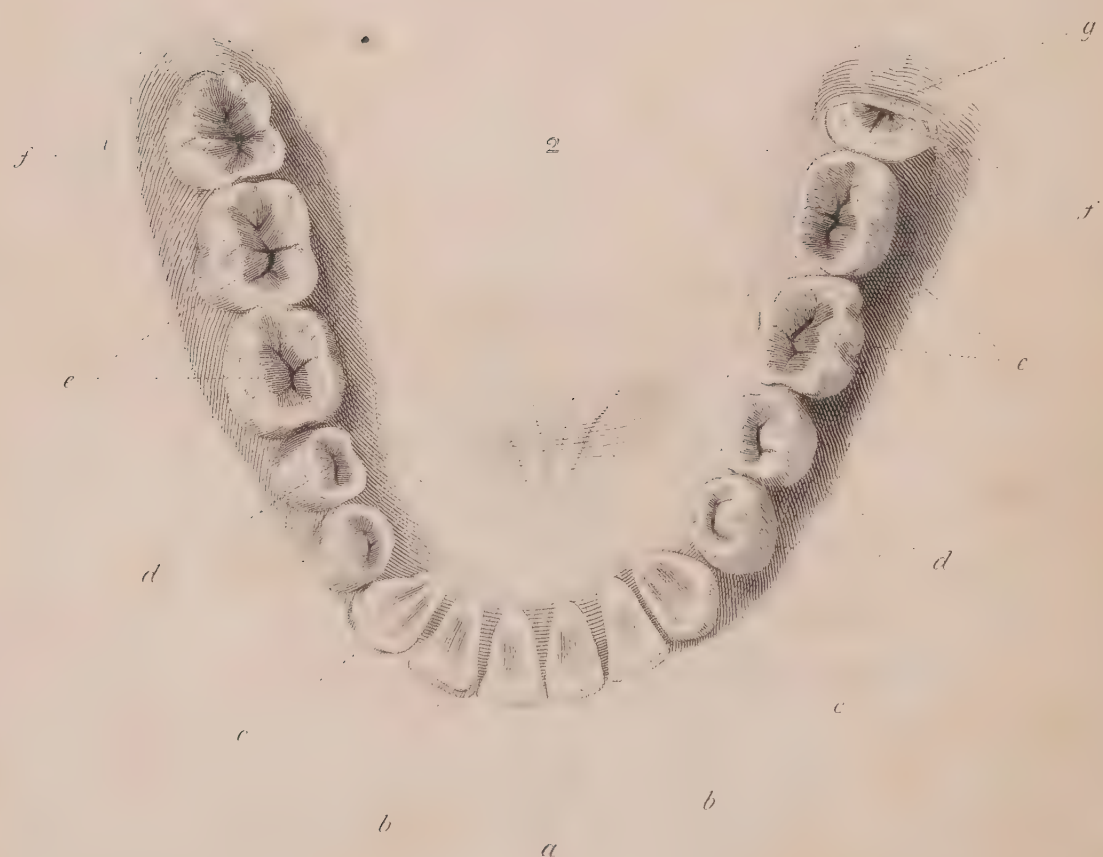
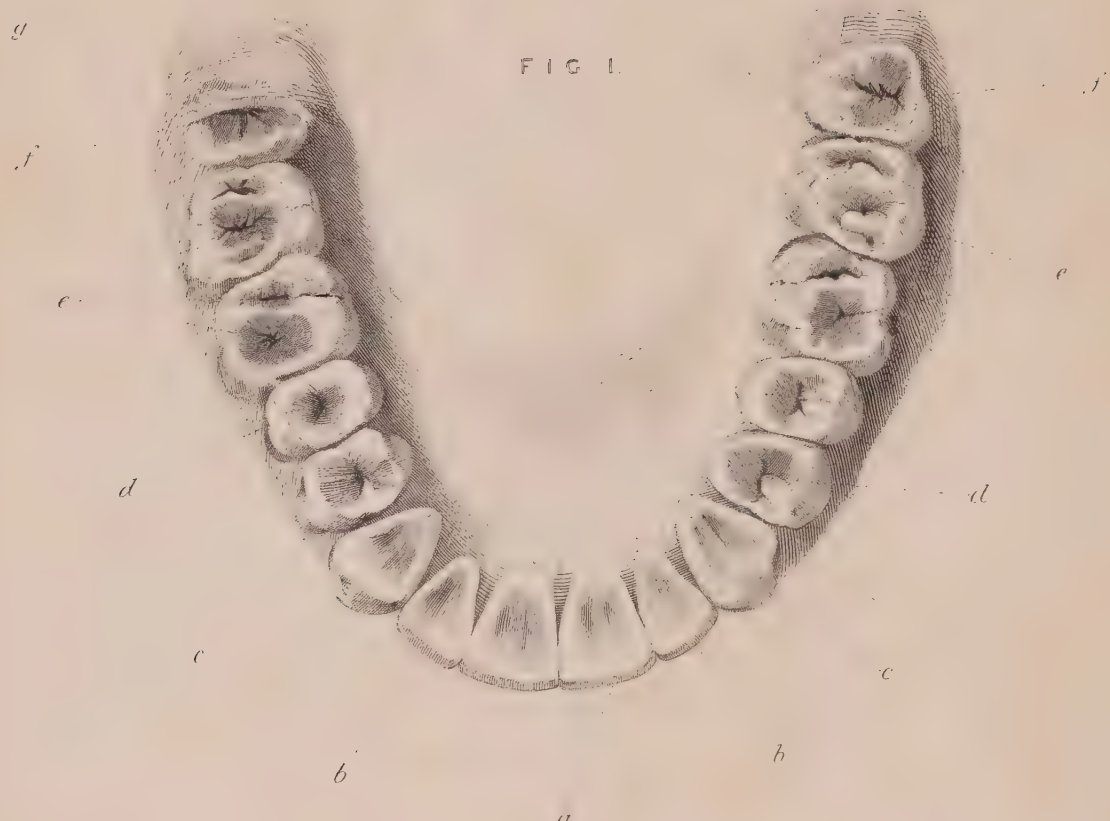
move the tooth. Sometimes, however, this cannot be accomplished, and the only remedy consists in extracting the contiguous molar tooth. The following case will serve as an illustration:—

CASE V. About three years ago, I was consulted by a lady residing in this neighbourhood, who was suffering from pain and tumefaction at the angle of the left side of the lower jaw. Upon examination, I found that the second molar tooth occupied nearly the extreme of the jaw, and beyond it I could just distinguish a small portion of the *dens sapientiæ*. I lanced the gum freely in the usual way, so as to facilitate the passage of the tooth, and ordered hot fomentations. After the lapse of a week, my patient visited me again, complaining that she had experienced no relief. The operation of lancing was repeated, but with no better success. The next consideration was the removal of the tooth; but from its situation, I found it was impossible to perform this operation, as no instrument could lay hold of it. After a consultation with Mr. Wood, her medical adviser, it was agreed to remove the *adjoining* tooth. This was accordingly done, and in a short time the patient was relieved from her sufferings, having sustained no loss,—for on seeing her again at the expiration of two years, I found the *dens sapientiæ* occupying the place of the extracted tooth.

Cases of genuine ear-ache are comparatively rare, and in most instances where there are no external

signs of disease in the organ, the pain may be traced to one or more of the molar teeth in the lower jaw in a state of decay, or to inflammation excited by the wisdom tooth in a state of confinement similar to the case above mentioned.

In rheumatic affections, and what is generally termed "cold in the face,"—when the pain is of a dull and obtuse nature, as compared with that acute pain which is occasioned by inflammation of the internal membrane when it first becomes exposed, the source of the suffering may in most instances be traced to the remains of carious teeth, the periosteum of which is subject to inflammation, and liable to be excited by every local or constitutional cause.



EXPLANATION OF THE PLATES.

PLATE I.

THIS Plate represents a complete set of permanent teeth; showing the posterior surfaces of the incisores and canine teeth; the grinding surfaces of the bicuspidates, the molares, and *dentes sapientiæ*; also the irregularities upon their grinding surfaces where food is liable to be retained, and consequently where decay takes place.

FIG. 1. The upper range of teeth; *a*, the front incisores, or cutting teeth; *bb*, the lateral incisores, or cutting teeth; *cc*, the cuspidati, or canine teeth; *dd*, the bicuspidates, or small grinding teeth; *ee*, the molares, or large grinding teeth; *ff*, the *dentes sapientiæ*, or wisdom teeth; *g*, the gum covering the half of one of the *dentes sapientiæ*, and thus forming a recess between the concave and pitted surface of the tooth and the over-lapping gum. In this situation particles of food are more liable to be retained than in any of the other parts of the teeth, and consequently the *dentes sapientiæ* are the most subject to caries.

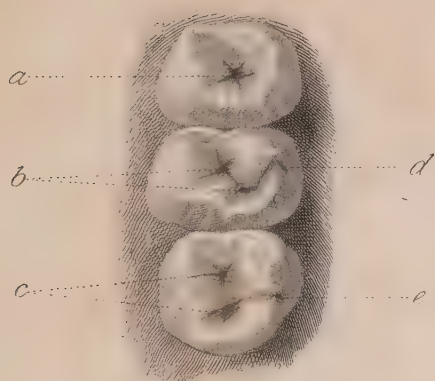
FIG. 2. A similar view of the teeth in the lower jaw; *a*, the front incisores; *bb*, the lateral incisores; *cc*, the cuspidati; *dd*, the bicuspides; *ee*, the molares; *ff*, the *dentes sapientiæ*; *g*, the same as described in the upper jaw.

PLATE II.

THERE is great variety in the formation of the surfaces of the molar teeth in different individuals; the few specimens in this Plate, however, will be sufficient to show the formation of those teeth which are, and of those which are not subject to caries.

FIG. 1 and 2 are teeth exceedingly liable to decay in consequence of food being retained in the deep pits upon their grinding surfaces. The parts which the letters point out, are not represented as being in a state of decay; but there is difficulty in showing the depth of the pits occasioned by the irregular formation of the enamel, without, at the same time, producing the appearance of decay as having already commenced. The teeth distinguished by the letters *a*, *f*, and *h*, are subject to decay only in one situation upon their grinding surfaces; *g* is liable to decay in two places; and *b*, *c*, *d*, and *e*, are not only liable to caries in two places on their grinding surfaces, but also in one on their sides; the latter is occasioned by a fissure which extends across the grinding surface of each of these teeth, and forms

FIG 1



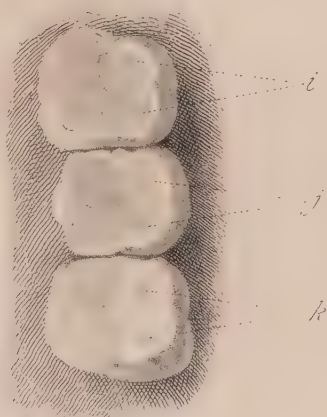
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3



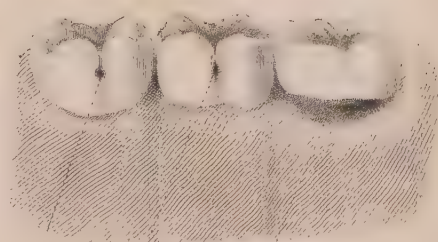
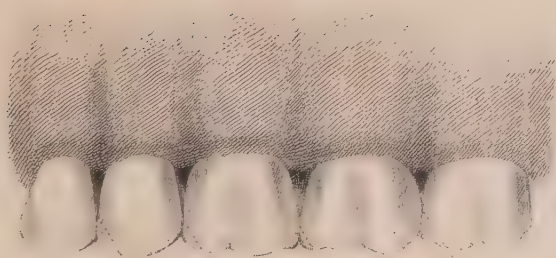
4



5



6



a pit in the side. If a tooth similar to some of those described be cut through in a longitudinal direction, the fissure will be found to extend through the enamel to the surface of the bone within. (See Plate IV., fig. 9, *b*.)

FIG. 3. The enamel is regularly distributed upon these teeth, and their surfaces are comparatively level; therefore, they are not subject to decay, because they are incapable of retaining particles of food.

FIG. 4. The surfaces of these teeth have been worn down by friction; consequently, they are not liable to decay, because no lodgment can take place. *i*, *j*, and *k*, show the enamel to be worn away, and the bone coming into action.

FIG. 5. A bicuspid of the upper jaw, showing the conical form of the crown of the tooth towards its neck; *l*, the contracted and fluted part, where decay in these teeth generally takes place.

FIG. 6. The bicuspidæ, the molares, and the *dens sapientiæ*, of one side of the upper jaw. *m*, *n*, *o*, and *p*, the situations where decay takes place on the lateral surfaces of these teeth. By the receding of the gums, interstices have been produced which are capable of receiving and retaining the particles of food.

FIG. 7. *q* and *r*, two molar teeth in the lower jaw, with fissures extending across their grinding surfaces, and running down their sides. This formation frequently occurs, and when deeply marked always produces decay. *s*, a *dens sapientiæ* of the lower jaw, in which decay has taken place. The

dentes sapientiæ are very subject to caries on the side next to the cheek, and it is occasioned by a tendency of the food to lodge upon the broad and flattened surface of the gum; the flattened formation of the gum, in this situation, is produced by the sudden thickening of the bone which forms the basis of the coronoid process.

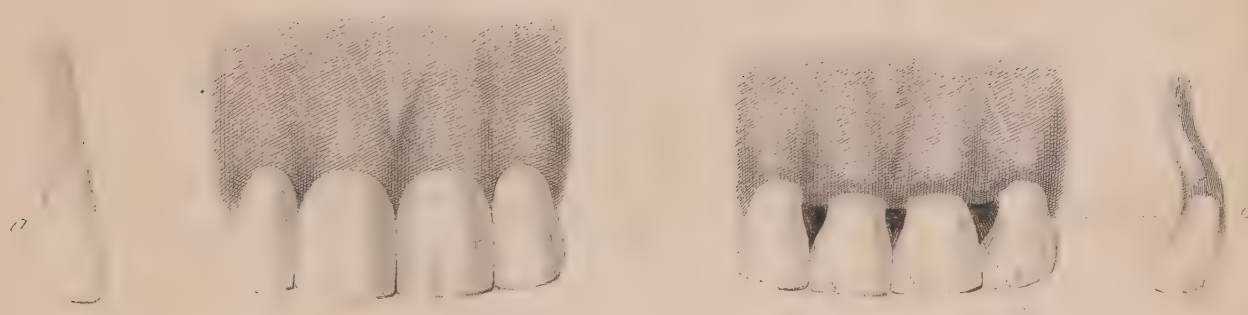
PLATE III.

FIG. 1 represents four incisores of the upper jaw which are not subject to caries, because the uniformity of their width admits of their sides uniting all the way from their cutting edges to the gums; and, consequently, no food can lodge between them.

FIG. 2, four incisors of the upper jaw, which are extremely liable to caries at their sides. The interstices between these teeth are occasioned by the conical formation of the teeth. Food is retained at the parts marked *bbb*, where the union of their sides terminates. The teeth marked *a* and *c* are represented as removed from their sockets, in order that their different formations may be seen more distinctly.

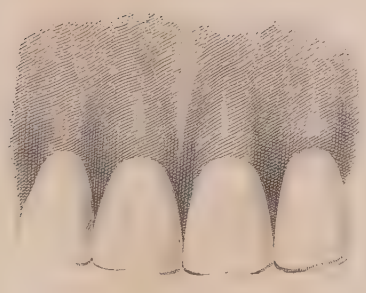
FIG. 3, four incisores of the upper jaw which are not subject to caries. The gums are in a healthy condition; they throw out processes which fill up the openings between the teeth, and exclude all extraneous matter.

Fig. 1.

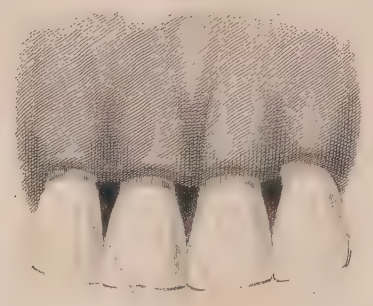


b b b

3



4

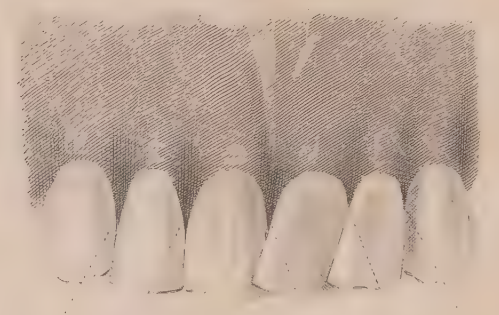


d d d

5

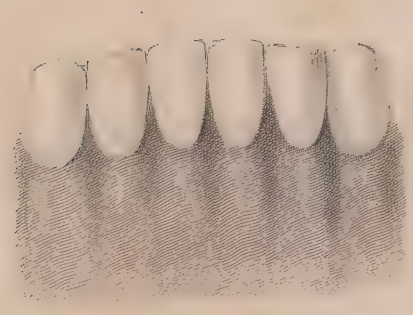


6



f f e e e

7



8

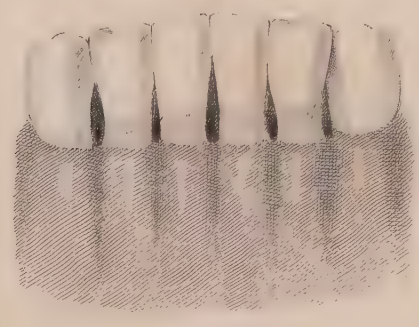


FIG. 4, teeth similar in formation to those last described. In these, the gums, so long as they remained in a healthy condition, filled up the openings between the teeth; but by neglecting to use the tooth brush, tartar has accumulated, the gums have receded, and interstices have been produced, which are liable to retain food and occasion decay at the parts on their sides which the letters *ddd* point out.

FIG. 5. When the teeth are apart from each other, as here represented, there is no liability to decay; interstices of this form being incapable of retaining food.

FIG. 6, the incisors and canine teeth of the upper jaw. The teeth to which the letters *ff* refer are not subject to caries; the formation of their interstices, and the state of the gums, being similar to those in FIG. 3. But from the irregular position of the teeth marked *eee*, the gums are prevented from filling up the openings between the teeth; and, consequently, food is retained at the points where the teeth unite, and decay is the result.

FIG. 7, the incisores and canine teeth of the lower jaw; showing the gums to be in a healthy condition, adhering firmly to the necks of the teeth, and filling up the openings between them.

FIG. 8, similar teeth, which have been neglected. Tartar has been allowed to accumulate, which has forced the gums from the necks of the teeth, and has occasioned the absorption of a portion of their sockets.

PLATE IV.

FIG. 1. A view of the posterior surfaces of the upper incisores. In general, the formation of these teeth is similar to the two marked *aa*, having smooth and rather concave surfaces posteriorly, which are incapable of retaining food; and, therefore, such teeth are not subject to decay in this situation; but occasionally they are deeply indented like those marked *bb*; consequently, food is retained in these depressions, and decay is the result.

FIG. 2, 3, and 4, the anterior surfaces of six front incisores of the upper jaw. These teeth usually present smooth and convex surfaces, similar to the representations given in Plate III., and are not liable to decay; but sometimes they are deeply pitted like the two marked *cc*; and, in other instances, they are defective in the formation and substance of their enamel, like those marked *dd* and *ee*. In these situations they are subject to caries, because they are capable of retaining food.

FIG. 5 and 6, a permanent molar tooth of the lower jaw of a child about eight years of age, cut through in a longitudinal direction, for the purpose of showing its internal structure, as compared with FIG. 7 and 8, a tooth of the same kind in a person upwards of fifty years of age.

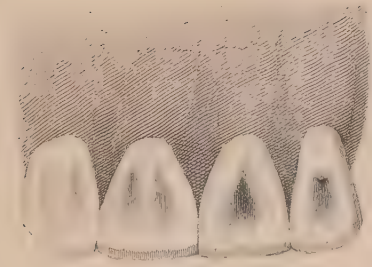
FIG. 5. *a*, the crown, or that part of a tooth which is covered with enamel, and exposed; *b*, the neck, or the part of the tooth which is embraced

FIG. 1

2

3

4



a a b b

c c

d d

e e

5

6

7

8

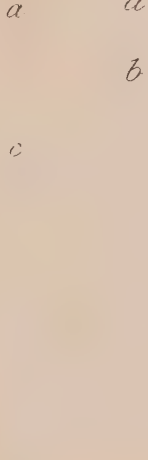


a
b
c

a

9

10



a
b
d
e

a
b
c

a
c
d
e

f

f

11

12

13



a b

b a

c

by the gums so long as they are retained in a healthy condition; *c*, the fangs, or that portion of the tooth which is imbedded in the alveolar process, or socket, and surrounded with a membrane called the periosteum.

FIG. 9 and 10 are representations of figures 6 and 7 magnified, for the purpose of showing more distinctly the distribution of the enamel on the one tooth as compared with the other; and also the change which is produced in the cavity of an old tooth by a gradual filling up of bone.

FIG. 9 represents prominences, *a a*, upon the grinding surfaces of this section, corresponding with two elevations of a similar nature upon the removed section, which, when together, formed a deep pit or fissure in the centre of the masticating surface of the tooth. It will be observed at *b*, that this fissure extends through the enamel, the consequence of which is, that the more liquid portions of the food are admitted and brought in contact with the surface of the bone. In this situation the food is retained, and cannot be dislodged by any process of brushing. This formation is by no means an uncommon occurrence, and, in such cases, decay may be said to commence upon the surface of the bone; but it must be evident to every one, that the disease is produced by external agency. *c*, the substance of bone, between the enamel and the cavity of the tooth, through which decay has to penetrate before it reaches the internal membrane

and produces toothache; *f*, the openings at the points of the fangs, where the blood vessels and nerves enter; *e*, the ducts through which they pass; and *d*, the cavity where they spread out upon the membrane which lines the internal walls of the tooth.

FIG. 10. *aa*, the grinding surface of this tooth is nearly level, so that no food can lodge; *b*, its enamel, solid and compact, which prevents extraneous matter from being admitted to the bony substance of the organ; consequently, a tooth of this formation is not liable to caries. *c*, the substance of bone between the enamel and the cavity of the tooth, thicker than in figure 9; *f*, the points of the fangs where the blood vessels and nerves enter; *e*, the ducts through which they pass, nearly obliterated; and *d*, the cavity almost filled up with bone. Circulation in this organ must be at a very low ebb, particularly at the points of the bone which are the most remote from the centre; nevertheless, we do not find a tooth of this description liable to decay.

FIG. 11. *aa*, the position which the canine teeth generally take when the jaw is not sufficiently expanded to admit them into the range; *bb*, the anterior bicuspid, which should be removed, and so allow the canine teeth to come into their proper place.

FIG. 12 and 13 are sections of a canine tooth of the upper jaw, showing its external and internal formation. This tooth is seldom affected with caries; and when decay does take place, it always begins

at the parts marked *a* and *b*, situations which are nearest to the internal membrane; and decay is never found to commence at the point marked *c*, which is the most remote, excepting in cases similar to the representations given in FIG. 3, where the enamel is defective in its formation.

PLATE V.

FIG. 1 represents one of the central incisores of the upper jaw shutting within those of the lower.

FIG. 2, the same, showing the method by which this deformity is remedied. A gold plate is accurately fitted and firmly secured to the lower range of teeth; it inclines inwardly accross the cutting edges of the teeth which inclose the upper incisor. In shutting the mouth, the posterior surface of the irregular tooth acts against the inclined surface of the plate; and by the pressure thus produced, the tooth is gradually moved forward into its proper situation. The plate at both ends encloses and rests upon the grinding surfaces of the bicuspidæ, which bear it up against the pressure of the irregular tooth, and prevent the lower edge of the plate from being forced against the gums. The same principle is adopted whether there be two or more of the upper teeth shutting within those of the lower jaw.

FIG. 3 is a view of the plate separated from the teeth.

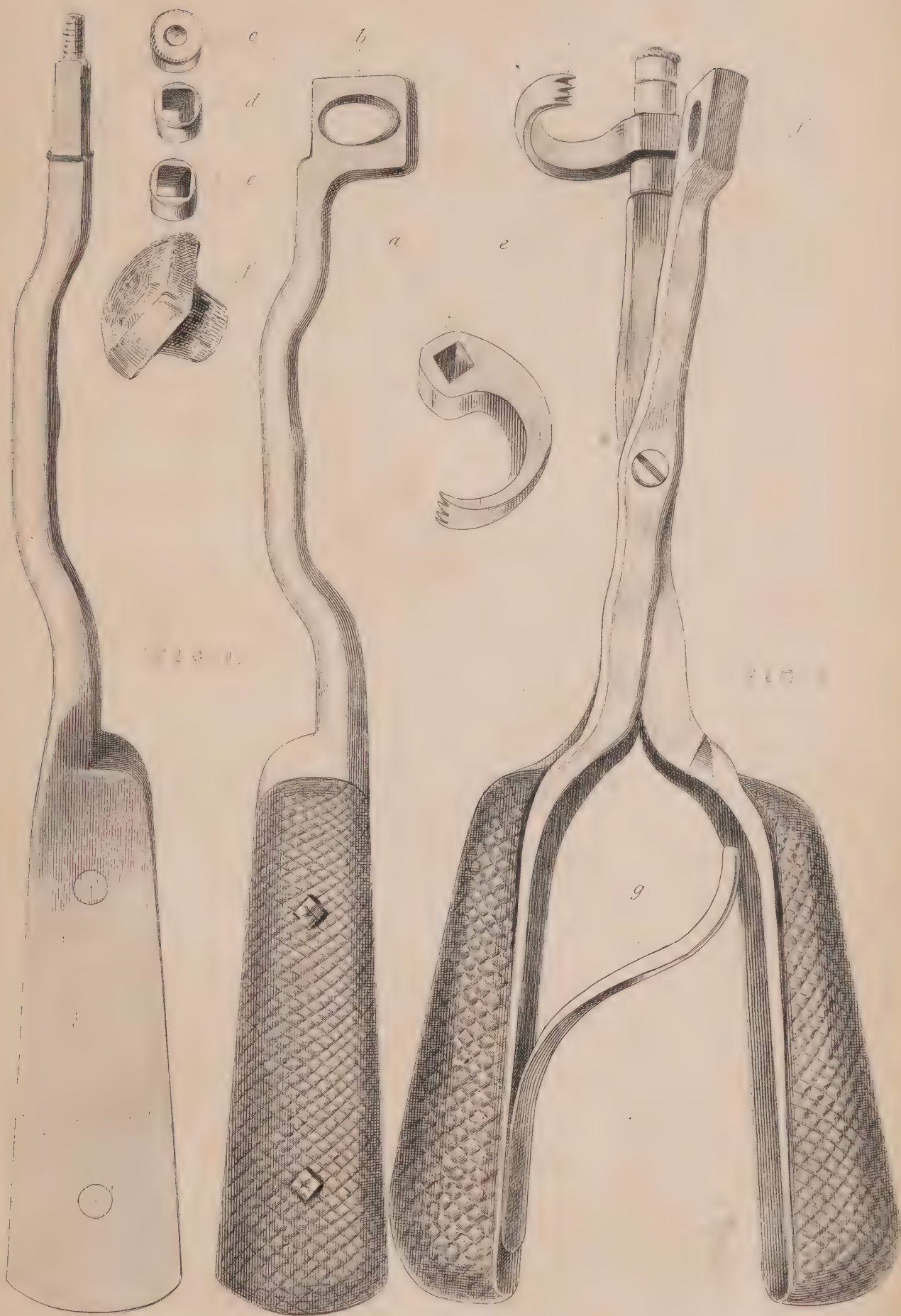
FIG. 4 is a plate adapted for two front incisors, similarly situated to the one described. In this

case, the bicuspidæ have not yet made their appearance; it, therefore, becomes necessary to support the plate against the molar teeth, and to prevent the lower edge of the plate in front from pressing against the gums; it is also supported against the cutting edges of the lower incisores.

PLATE VI.

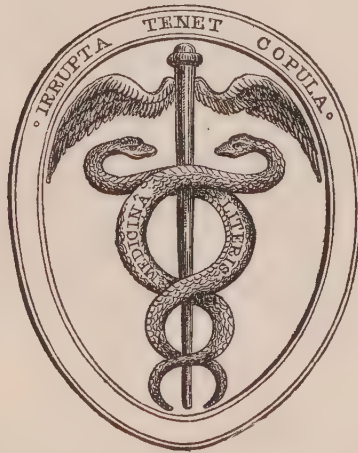
FIG. 1 is a view of the separate parts of a newly invented instrument for the removal of teeth. *a*, the claw; *b*, the fulcrum; *c*, the nut or screw; *d* and *e*, the washers; *f*, the cork.

FIG. 2. the claw, in consequence of the square formation of its bore, is retained in a fixed position, so that its point, *a*, is always in a correct line with *b*, the fulcrum. By placing the washers *d* and *e* together, the claw is made to act either before or behind the fulcrum. The nut, or screw, *e*, at the extreme point of the instrument, secures the claw and washers in their respective situations. The cork, *f*, is made to fit the bore in the fulcrum, and is placed in its situation with the greatest facility; this is an advantage, it being desirable often to use a new cork. The blades of the instrument are kept sufficiently apart by the spring, *g*, so as to admit the largest tooth between the point of the claw and the fulcrum.



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